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GAS MEASUREMENT

ERRATA.

PAGE 19, para. 37, line 7,—
for "one hundredth"
read "one hundred"

PAGE 26, para. 59, line 9,—
for "62·02°" read "60·02°"
Same para. line 17,—
for "60°" read "62°"

PAGE 36, para. 81, line 4,—
for "a point below **X**, &c."
read "a point **X**, below &c."

PAGE 39, para. 84, line 3 from top,—
for "cock **A**" read "cock **A′**"
and in footnote,—
for "**A**" read "**A′**"

PAGE 44, para. 93, line 14,—
for "first and last readings of &c."
read "first and last readings if &c."

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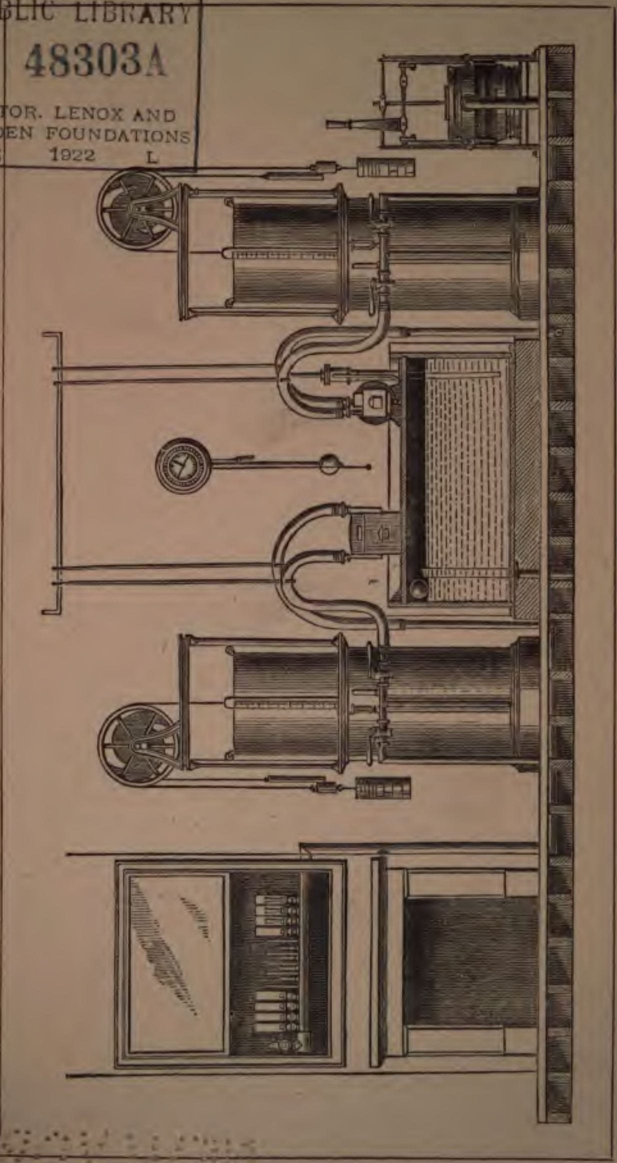

GAS MEASUREMENT

AND

GAS METER TESTING,

UNDER THE SALES OF GAS ACT.

1. It is a remarkable fact in the history of gas-lighting in this country, that although Gas Companies at the outset adopted the *cubic foot* as the unit for gas measurement, and, when meters were introduced, actually sold gas under the authority of their respective Acts of Parliament at rates due to a 1,000 or 100 cubic feet, there should have been no cubic foot measure or any gas measure included among the standard measures of the nation, and that gas measures of all kinds, inclusive of gas meters, should have remained until the year 1861, altogether exempt from any such examination and verification by public officials, as all other measures of capacity, &c., were subjected to by law.

2. In the year 1859 an Act was passed entitled "An Act for Regulating Measures used in Sales of Gas." This Act was modified by two subsequent Acts, which deferred the date at which it was to come into operation, changed some of the authorities who were to carry its provisions into execution, and finally rendered its application permissive instead of compulsory—dependent, in fact, upon the resolutions of magistrates and other local authorities. As a consequence of this last alteration, the Act is now, after 12 years' duration, obligatory only in one county and in 52 boroughs and cities in England. Nevertheless the Act is virtually in operation all over the kingdom, for very few meters are put into use without having been previously verified and stamped by a Public Inspector.

3. In the original Act it is enacted that—

Clause II. After the passing of this Act, the only legal Standard or Unit of Measure for the Sale of Gas by Meter shall be the Cubic Foot, containing 62·321 Pounds, Avoirdupois Weight, of Distilled or Rain Water weighed in Air at the Temperature of Sixty-two Degrees of *Fahrenheit's* Thermometer, the Barometer being at Thirty Inches, except as relates to Contracts made before the passing of this Act by which a different Unit of Measure is adopted, which Contracts may not be renewed.

Clause III. Within Three Months next after the passing of this Act, Models of Gasholders measuring the said Cubic Foot, and such Multiples and Decimal Parts of the said Cubic Foot as the Lord High Treasurer or the Commissioners of Her Majesty's Treasury of the United Kingdom for the Time being shall judge expedient, and, from Time to Time after the Expiration of the aforesaid Period of Three Months, Models of such further Multiples and Decimal parts of the said Cubic Foot as the Lord High Treasurer or the said Commissioners shall from Time to Time think expedient, shall be carefully made, with proper Balances, Indices, and Apparatus, for testing the Measurement and Registration of Meters, and such Models shall be verified under the direction of the Lord High Treasurer or the said Commissioners, and when so made and verified shall be deposited in the Office of the Comptroller General of the Exchequer at *Westminster*; and copies of the Models so from Time to Time deposited, verified as aforesaid, shall be sent to the Lord Mayor of *London*, and the Chief Magistrate of *Edinburgh* and *Dublin*, and to the Chief Magistrate of such other Cities and Boroughs and to such other places and Persons in Her Majesty's Dominions as the said Lord High Treasurer or the aforesaid Commissioners may from Time to Time direct; and the said Lord High

Treasurer or the said Commissioners shall appoint a competent Person or Persons to design and make, subject to the Approval and by Direction of such Lord High Treasurer or the said Commissioners, Stamps of a uniform Design to be used for stamping Meters throughout the United Kingdom, with only such Variations of Numbers or Marks thereon as shall be sufficient to distinguish each Inspector's District.

4. The clauses which follow the foregoing relate to the appointment of meter inspectors, the models, or copies, of the standard measures to be used in testing meters, the verification of meters, fees for such verification, &c., &c.

In accordance with the provisions of the third clause, the following standard of cubic capacity were accordingly constructed under the direction of the Astronomer Royal, namely, a measure of such capacity as to contain 62·321 lbs. of distilled water at the temperature of 62° Faht., and with the barometer at 30 inches (which measure is usually called the *cubic foot bottle*), and three *gasholders* of the respective capacity of $1\frac{1}{10}$, $5\frac{1}{2}$, and 11 cubic feet. In 1871 the Royal Commissioners of Weights and Measures increased the number of gas measures by including GAS METERS of a very perfect character as secondary standards (60).

CUBIC FOOT BOTTLE, &c.

5. The *cubic foot bottle*, fig. 1, is merely an outcome of the late Mr. Alfred King's "Transferrer," fig. 2. The "Transferrer," in truth, consisted of a cubic foot bottle, mounted above an air chamber, and communicating therewith by means of a syphon-pipe provided with a cock, so that connection between the bottle and the air-chamber could be established or cut off at will. The hypothesis, on which this instrument was constructed, is, that if

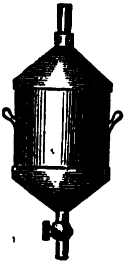

FIG. 1.

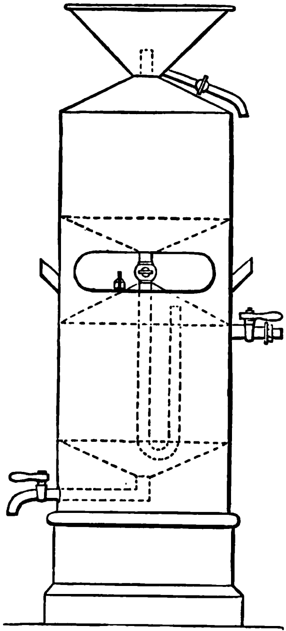

Fig. 2.

the upper vessel or bottle be charged with water, and the water then be discharged into the air-vessel below, a quantity of air exactly equal to the volume of water admitted would be expelled from the outlet of the air-vessel. The suggestion of the bottle form for a cubic foot measure was not lost upon the Astronomer Royal and Professor Miller, and this form was adopted for the standard, with the idea apparently of using it in some such way as Mr. King had devised. Unfortunately, Mr. King's hypothesis was not borne out by the experience of any one who worked with the transferrer. It was found that the volumes of air discharged from the chamber sensibly differed, and that it was impossible to control or even to fully realize the circumstances which induced the variations. This, however, was not the only objectionable fact, in respect to the transferrer. The labour which its use demanded was considerable, for 62·321 lbs. of water had to be lifted for the purpose of charging the bottle for each cubic foot of air measured, and the operation was altogether slow and tedious. The writer was greatly distressed in his efforts to use the transferrer for the graduation of test gasholders in the year 1861, and, after a week's unprofitable labour, cast the transferrer aside, and applied the bottle as a direct measurer, in the manner shown in fig. 3, being at the time quite unaware that Mr. George Glover had previously devised the direct transferrer, shown in fig. 4. The writer ventures hink his method the best. The measurement is nearly automatic, little more than a very moderate increase and reduction

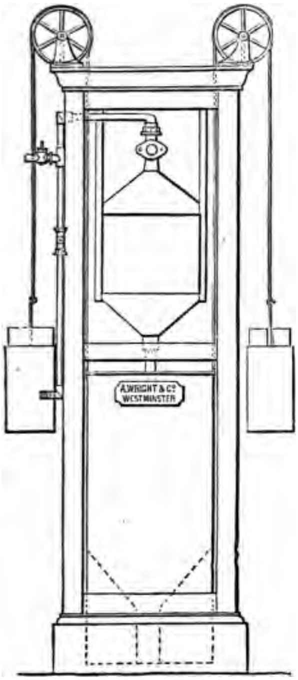

FIG. 3.

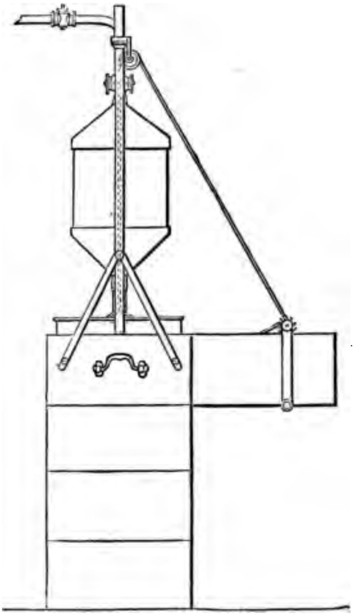

FIG 4.

in the counterpoise by means of convenient loose weights, in order to discharge and recharge the bottle. On this method the operation of measuring a test gasholder is reduced to the minimum in labour, is exceedingly expeditious, and if the operator be experienced, the results are unfailingly accurate.

6. There is yet another method of using the cubic foot bottle—namely, that employed by the gas examiners of London for testing experimental meters. The bottle is fixed upon an upright board and terminates at each end with a glass tube, the lower marked to indicate the zero, and the upper marked to indicate the terminal point. The bottle is provided at top and bottom with suitab

stop and vent cocks, and a pipe connects the lower part of the bottle to a water-cistern, while the upper part of the bottle is put into communication by means of another pipe with the instrument to be verified. Water is admitted at a regular rate through the lower cock, after adjustment to the zero line, so as to give a uniform flow of air from the bottle, and at any desired or possible pressure. The arrangement is, undoubtedly, a very excellent one, and serves its purpose well, but it is attended with various disadvantages—first, the water must be supplied from a cistern above the bottle, and this cistern must either be of somewhat large area or be placed several feet above the bottle, as otherwise the reduction of the head of water which takes place will affect the rate of discharge to such an extent as to render necessary a constant attention and adjustment of cocks; secondly, a cubic foot of water is needed for every cubic foot of air measured; hence, either much water must be wasted, or the labour of lifting, or the more objectionable process of pumping up from a lower cistern resorted to. This method is due to the gas referees, and the instruments were made by Mr. Sugg, and are called "The Referees' Cubic Foot Measures."

7. These objectionable and troublesome processes are all avoided in the writer's method of using the bottle as a meter measurer. It is simply to interpose a well-made wet governor between the air outlet of the transferrer, fig. 3, and the meter. No error can or does arise from the intervention of the governor. The latter is weighted to the needful extent, the bottle, governor, and meter are first connected together by pipes, and their aëriform contents brought into equilibrium with the atmosphere. The instant the discharge of air from the bottle commences, the governor comes into action, and when the air has been completely discharged from the bottle, the gasholder of the governor descends and delivers the air which it has received, through the meter, and all once more comes into equilibrium with the atmosphere. The system has been severely tested by the writer, and appears both on the grounds of reasoning and of demonstration to be free from objections, while it certainly possesses strong claims on account of its simplicity, the

small amount of trouble it demands, and the continued use of the same volume of water, which last may therefore be readily brought to and maintained at a due temperature. It is to be understood, however, that such direct measurement from the bottle is by no means a necessity in the case of a meter, and can only be readily applied to small meters. The method of measuring meters directly by the transferrer, moreover, does not give absolute accuracy, for the cubic foot of the bottle is a cubic foot under atmospheric pressure only; but the error is very small, inasmuch as under a mean barometric pressure, and with a meter or other measure opposing a resistance of so much as half an inch water pressure, the reduction in volume would be no more than 1-768th part, or just over $\frac{1}{8}$th per cent.

GASHOLDERS.

8. The test gasholder (see frontispiece) is the instrument which is used, in meter-proving rooms, for the verification of the measurement of gas meters, and consists, like an ordinary gasholder, of a *water tank* and a cylindrical *bell* or *holder* fitting into the tank. The holder is free to rise to a certain height, and is made to contain a specific volume of air or gas, and it is constructed in such a manner as to fulfil the following conditions, viz.:—

(1.) *The vertical descent of the holder while its contents are being discharged.*

(2.) *The adjustability of its operating weight, so that it shall deliver gas at any pressure up to a pressure equal to 3 inches head of water.*

(3.) *The uniformity of its pressure, whatever it may be, throughout the descent of the holder.*

(4.) *Great accuracy in its measurement.*

9. The general construction and action of a test gasholder will be understood from the following remarks and explanations.

10. The vertical descent of the holder is secured by affixing to the top and bottom of the holder a certain number of guide-wheels.

Those at the top of the holder run against pillars, which rise from the edge of the tank, while the bottom wheels run against guide-plates within the tank.

11. Secondly the holder is made heavier than is requisite for it to give the maximum pressure, and is suspended from the end of a cord or strap, which passes over the grooved wheel on the beam above the pillars, and sustains also a series of counterpoise weights, the removal of one or more of which causes the holder to discharge its contents at pressures ranging from one-tenth of an inch up to 3 inches head of water.

12. In respect to the third condition; it is to be remarked that when the holder is immersed, it necessarily displaces a quantity of water equal to the bulk of the metal composing the holder's circumference. If we assume the specific gravity of this metal to be seven times that of water, and its bulk to be one-tenth of a cubic foot, then the weight of the metal immersed would be 42·62 lbs.; one-seventh of which, or 6·23 lbs., would be the weight of the water displaced, and also be the weight which the holder would loose by immersion. To compensate for this loss and to render the pressure of the holder equal throughout its descent, a spiral curve and a weight are employed. The spiral is formed upon, and curves inwards nearly to the centre of, a metal plate, which is fixed on to the end of the spindle upon which the large grooved wheel revolves. The weight, which is proportioned to the compensation required, is suspended by a cord from the outer end of the spiral. When the holder is raised to its greatest elevation the weight acts with its greatest force. As the holder descends the large wheel partly rotates, and the spiral is also turned, so that the cord approaches the centre, the leverage thereby becomes less, and the compensating weight is made to act with a force, diminished in exact proportion to the weight lost by the holder throughout its descent into the water. Formerly the compensating curve was made with *one* arm only, and its varying leverage, as it changed its position by rotation, caused irregularities in the pressure given by the holder. To obviate this evil, the writer some years since

constructed the compensated, or two-arm, curve shown in the frontispiece.

13. And, lastly, accuracy in measurement is secured by filling the bell of the gasholder with air, by successive discharges from an exact duplicate of the government cubic foot bottle (figs. 1, 3, and 4), marking the elevation of the bell, for each cubic foot of air thus delivered into it, on two vertical scales, one affixed to the front, and the other to the back of the bell. The primary divisions thus determined are sub-divided so as to indicate *tenths* and *hundredths* of a cubic foot. When the gasholder is properly levelled and adjusted, the relative divisions on the two scales will agree; but if the holder be not levelled and adjusted properly the divisions will not coincide. In practice the front scale alone is generally regarded. In order to enable the scales to be accurately observed a pointer or some other appliance is fixed upon the tank opposite each scale.

14. Gas or air is admitted to and discharged from the holder through a *stand-pipe*, which is fitted to the front of the tank, and also passes up the centre of the tank to a few inches above the water line. The front or *external* part of this pipe is fitted with two cocks, and with a pressure-gauge and a thermometer to show the pressure and temperature of the issuing gas. It is also provided at the lower part with a socket and plug, so that any water which may by accident have entered the pipe may be drawn off. The tank is further provided with a cock at the water line, and with a socket and plug at the base for discharging the water when needful.*

SECONDARY APPARATUS AND ITS ARRANGEMENT.

15. Meters, especially wet meters, must stand on a perfectly level surface when being tested. To secure this condition, as well

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* The foregoing descriptive remarks in respect to test gasholders, apply *specially* to such instruments as are used by Public Inspectors, and *generally* to the government *standards*, which are of similar but of more expensive construction.

as to render the operations easier, meters of small and moderate sizes are placed for testing on a level stand, called a *proving-bench*, the top of which is 3 ft. to 3 ft. 6 ins. above the floor line. In the frontispiece the proving-bench is represented as a water cistern with a top upon it. It is shown in section in order that the way in which the top plate is fitted may be seen.

16. The cistern is convenient as to size, &c., if made about 5 ft. 6 ins. to 6 ft. long, 2 ft. 6 ins. wide, and 2 ft. 6 ins. deep; its elevation to the needful height being effected by placing it upon blocks or brickwork, leaving a part of the space below open from back to front. The edge of the *front* plate of the cistern should be *one inch above*, and the edge of the *back* and *end* plates *three inches above* the level of the top slab. The top slab should be 1 in. or 1¼ in. thick, the edges, in the direction of its length, should be rebated, and the upper surface be planed perfectly flat. The width of the top should be 3 ins. less than the internal width of the cistern, and it should be so adjusted as to leave an opening along the back of the cistern 2 ins. wide, and an opening the front of the cistern 1 in. in width. These openings should be covered with strips of perforated zinc, fitting upon the rebates of the top and into saw-cuts in the back and front plates. The gratings thus formed permit the free flow of water into the cistern, when wet meters are being emptied, after having been tested. The raised edges round the top of the cistern prevent the slopping over of water. The cistern should be fitted with *water-supply pipe and ball-cock*, and with an *overflow or waste-pipe.*

17. As the water has to be drawn from the cistern for the purpose of charging wet meters, a *small pump* is also required, which may be fixed on the cistern as shown, or be placed in any other situation which may be more convenient.

18. The testing apparatus is convenient for use when arranged in the way shown in the frontispiece. The proving-bench stands between two gasholders, one of which is for use with gas, while the other, on the right, is for use with air, its inlet being connected to a *pair of double-blast bellows.*

19. From the outlets of the holders *flexible tubes* are extended and terminate in *brass sockets*, into which *cones*, of the size requisite to fit into the unions of the meters about to be tested, are screwed. These tubes and cones serve to connect the gas-holders to the inlets of meters. Similar connections are needed for the outlets of meters, and are shown on the pipes which descend to the floor and on the gas side are continued to the *float of lights* enclosed in the chimney breast. On the air side the pipes should be extended to some convenient point of discharge beyond the room, in order to prevent smell and the possibility of the explosion of the mixture of gas in a meter (41) with the air from the holder (49). Each outlet should be fitted with a *thermometer*, and the air outlet with a 2-inch main cock. The use of these, as well as of the cock on the end of the float, will be explained further on. It will suffice to say here that the last-mentioned main cock should be fitted with a piece of 1¼ iron piping projecting into the chimney, in order to carry off unconsumed gas. The float of lights is enclosed in a frame of wood or iron, the upper half closed in, while the lower part is provided with a sliding glazed shutter, which is to be drawn down when many lights are burning. The bottom part of the frame is left wholly or partly open for the passage of air to the flames, and at the top inside, an opening made into the chimney. In some cases the burners may be fitted in the space usually occupied by the stove. If there be no chimney available, and the room be open in the roof and well ventilated, the float may be fixed at any point in the room, at a height of at least two feet above the tops of, and as *far removed* as possible from, the holders.

20. The clock shown in the frontispiece is of the description called a *minute clock*. It is constructed to strike every minute, and is extremely useful in the adjustment of the gas, passing through meters, to the required rates per hour (38).

21. A *torch burner* for applying a flame round the meters and connections during the gas test is also necessary. A *second torch* is also required for the float of lights. Each consists of a small

burner fitted on a short handle, and supplied with gas through a flexible tube.

22. The advantages of the proposed arrangement are:—The apparatus is brought into close and convenient proximity—the water used for wet meters, by being kept in the cistern, is maintained as nearly as possible at the same temperature as that in the gas-holder tanks, and by repeated use becomes charged with gas and with its condensible constituents*—the heated products from the gas consumed in the float of lights are prevented from seriously affecting the temperature of the room, while the use of two gas-holders at one bench facilitates the inspector's operations, as he can readily conduct the tests for soundness and for registration at the same time.

23. In towns where a large number of meters will require to be tested, *four* or even *six* gasholders may be needed, but in most cases *two* will be sufficient, and the *most useful* are those of *ten* cubic feet nominal capacity. In some cases a five-feet holder is used for testing for soundness (41), and a ten-feet holder for the test for registration (44 *et seq.*). *One-foot* holders are *almost useless* for meter testing.

24. As meters of too large a size to be placed on the proving bench have sometimes to be tested, it is advisable to provide a *level slab* or *grating* in front of the proving-bench for such meters to stand upon, and when the meter evidently requires for its verification the delivery through it of more than 10 cubic feet of

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* "Water is never met with naturally in a state of purity. Rain water, collected "after a long continuance of wet weather, approaches nearest to it, but even this "always contains atmospheric air to the extent of about 2½ volumes of air in 100 of "water" (Miller's Inorganic Chemistry, p. 41). Water possesses a like power of absorption on all gases, but in varying degree. Clean water induces also a partial condensation of the hydro-carbon compounds of coal gas, hence the water used to charge wet meters, in testing operations, should be as nearly as possible saturated with gas and its condensible constituents. If clean water be used the gas should be allowed to flow through the meter for a little time before the test is made, and the purer the water the greater the necessity, as a rule, there is for this practice.

air or gas, its inlet should be connected to the outlets of both holders by means of a coupler, so that the holders may be successively discharged, and as, in some cases, the contents of even two holders will be insufficient, it is advisable also to arrange their inlet pipes so that both can be expeditiously filled either with air or with gas. If these arrangements be made, the holders can be alternately filled and discharged and a continuous delivery of air or gas through the meter be maintained for any length of time.

25. In the frontispiece and foregoing remarks, one holder is represented for use with air. The writer considers, however, that it is best to use gas for all the testing operations, and for the following reasons:—first, it is difficult to ascertain with air whether the joints of the connections are sound, which can easily be determined by the application of a flame when gas is used; secondly, it is far more difficult to register wet meters at the low-water level with air than it is with gas. If air be used the bellows are not indispensable, but without them the time and labour in filling are at least quadrupled.

26. It will be more convenient to read from the scales if the gasholders are placed on blocks a few inches in height. The base should be level and the graduations of the back and front scales should coincide, and although they are not likely to vary after the gasholder has once been carefully adjusted, it will be as well to observe, now and then, whether they continue to agree, and also to try the soundness of the bell and joints by filling the holder with air or gas and allowing it to stand with three inches pressure on for half an hour or so. The proving-bench should also be tried occasionally with a spirit level.

ON THE KINDS OF METERS TO BE TESTED, &c.

27. By the 12th Clause of the "Sales of Gas Act" it is enacted that:—

"No meter shall be stamped which shall be found by the inspector to register, or be capable of being made by any contrivance for that purpose, to register, or by increase or by decrease of the water in such meter, or by any other means practically prevented in good meters, to register quantities varying from the true standard measure of gas more than two *per centum* in favour of the seller or three *per centum* in favour of the consumer; and every meter, whether stamped or unstamped, which shall be found by such inspector to register or be so capable of being made to register quantities varying beyond the limits aforesaid, shall be deemed incorrect within the meaning of this Act; and every meter which shall be found by any such inspector to measure and register quantities accurately, or not varying beyond the limits aforesaid, and shall be found incapable by any such means as aforesaid of being made to register quantities varying beyond the limits aforesaid, shall be considered to be correct, and be stamped as aforesaid in such manner and on such part of the meter as shall be specially directed by the authority appointing him, or in default of such direction as shall, in his opinion, best prevent fraud. Provided always, that every meter having a measuring capacity at one revolution or complete action of the meter of not less than five cubic feet, and having permanently marked upon it in some conspicuous place, the words 'without float,' shall be stamped by the inspectors, if found correct, within the meaning of this Act, in all other respects except that it is capable of being made by abstraction of water to register incorrectly against the seller of gas, but it shall not be lawful after the time aforesaid to use in the sale of gas any such meter, when so stamped by the inspector, except by written agreement between the buyer and seller, specifying that this description of meter shall be used."

28. It will be seen from the above clause that two classes of wet meters are permitted to be stamped, viz.,—those which are *incapable,* and those which are *capable* of being made to register more than three per centum against the seller, on condition, in in respect to the latter, that such meters shall be of such size as to pass at least five feet per complete action, and be distinctly marked *with the words "without* float." Many, if not most, of the meters

"without float," will be of the kind called "station meters," from the fact of their construction being identical with those used in gas works and stations for measuring the gas manufactured.

29. Meters of the kind just mentioned, as well as all others of five or more cubic feet, measuring capacity per revolution, which have *no* float must be inscribed as "without float," and these words are best put on a badge bearing the maker's name, number of the meter, and its capacity per revolution and per hour. The badge should be screwed on to the front of an iron-cased meter, and the inspector's stamp should cover one or more of the screw heads.

30. Every meter submitted for testing to an inspector appointed under the "Sales of Gas Act," must have affixed upon it a badge, specifying "its measuring capacity at one revolution or complete action of the meter, and also the quantity per hour it is intended to measure in cubic feet, or multiples or decimal parts of a cubic foot."

31. On every ordinary wet meter there are *two* plugs, *one* on the upper part, called the *charge-plug*, and *one* at the lower part of the case, called the *syphon* or overflow *plug*. Both these plugs are in front of the meter case.

32. In the index of every ordinary meter, wet or dry, there is a small metal drum as in the wet meter, fig. 5; or, in lieu of the drum, an additional circle on the index plate, as in the dry meter, fig. 6. This drum or circle is divided into 2, 5, 10,

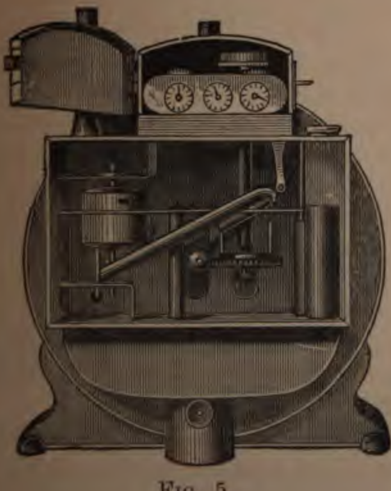

FIG. 5.

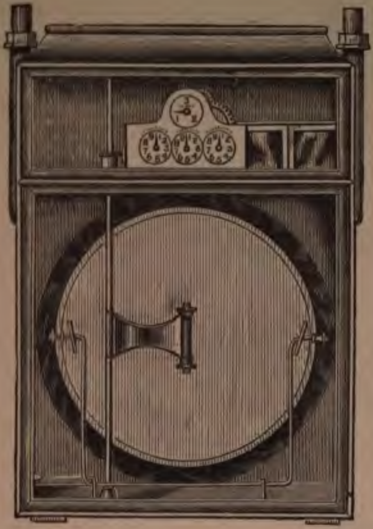

FIG. 6.

or more principal parts, representing as many cubic feet of measurement by the meter. It is by finding the quantity of gas, measured by the gasholder, which is required to pass through the meter in order to cause the index drum, or the pointer of the circle, to make an entire revolution, that the accuracy or the inaccuracy of the meter is determined.

TESTING OPERATIONS.

33. Before a *wet meter* can be tested, it must be properly charged with water. The manner of effecting this is as follows:— Remove the corks or stoppers which are usually placed in the inlet and outlet unions by the maker, or, better, take off the caps and linings. Set the meter, if of moderate size, on the proving-bench—or, if it be a large one, on the ground or floor—taking care that it stands perfectly level. Remove from ordinary meters the two plugs mentioned in a preceding paragraph (31), and pour water through the socket from which the charge-plug is removed until a free flow ensues from the meter at the syphon socket. Leave the meter undisturbed till all dripping of water has ceased, replace the plugs, and the meter is ready for testing.

34. *Dry meters* require no other preparation for testing than the removal of the stoppers or of the caps and linings, and the *placing level on the bench.*

35. Cones of suitable size to fit into the unions of the meters [illegible] be tested are to be screwed into the sockets on the ends of the flexible tubes of gasholders, &c. The cones on the *gasholder pipes* are to be inserted into the *inlets*, and the cones on the *other pipes* into the *outlets* of the meters. The junctions must then be made sound with a little putty pressed round the cones and upon the tops of the unions.

36. By Clause 13 of the "Sales of Gas Act" it is enacted that:—

"The following rules shall be observed by the inspectors in testing meters under the provisions of this Act:—

37. "Firstly, the meter shall be tested for soundness or leakage only, and not for per-centage of error, when fixed on a horizontal base, and with the gas under a pressure equal to a column of water three inches high, with a light or lights consuming not more than one-twentieth part of its measuring capacity *per* hour marked thereon, nor less than one-half of a cubic foot *per* hour, for all meters of a measuring capacity not exceeding one-hundredth cubic feet *per* hour, and not more than one-fortieth part of its said measuring capacity *per* hour, for all meters of any greater measuring capacity per hour than one-hundred cubic feet; and all meters found to work under such test shall be deemed sound meters, and any meter found not to work under such test shall not be stamped."

38. "The meter to be tested for per-centage of error shall be fixed on a horizontal base, and shall be tested at a pressure equal to a column of water five-tenths of an inch high, and passing the quantity of gas or atmospheric air *per* hour which shall be marked thereon as its measuring capacity *per* hour, and the water used in such testing, and the air of the room in which such testing shall be made, shall be as nearly as practicable of the same temperature as the gas or air passed through the meter."

39. The testing operation therefore consists, in respect to dry meters, of two parts, viz.,—test for *soundness* and test for per-centage, *fast or slow*, and in respect to the wet meter, of three

parts, viz.,—tests for *soundness*, for per-centage *fast*, and for per-centage *slow*.

40. Presuming that the gasholder has been filled with gas, the meter placed on the proving-bench, charged with water, plugs replaced, and the inlet and outlet connected with the proper pipes in accordance with preceding paragraphs, the mode of performing the testing operations may now be illustrated.

THE TEST FOR SOUNDNESS.

41. With, say half-inch pressure on the gasholder, pass sufficient gas through the meter to expel the air. When this is done, shut off the gas and remove all the loose weights of the gasholder in order to get three inches pressure. Close all the cocks on the float of lights, and turn on the gas to the meter. Then open one or as many burners as may be necessary, and regulate by their cocks until gas is passing through the meter at the rate prescribed by the Act, which rate is as follows for the various sized meters, viz:—

Meters of a capacity to pass 10 cubic feet or less per hour.	Under this test are to pass	Half-a-cubic foot per hour.	
Meters of a capacity to pass from 10 to 100 feet per hour.	Under this test are to pass	$\frac{1}{20}$th	Of their measuring capacity per hour.
Meters of a capacity to pass more than 100 feet per hour.	Under this test are to pass	$\frac{1}{40}$th	

42. Next, pass a flame round the meter and connections.* Should a leak exist in any part of the case, the meter must be

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* *This is* not advised for very large meters. See under "Test Meter."

jected as *unsound*, and also if the index fails to record the passage f gas. In this test it is sufficient to determine that the index oves, and in something like apparent agreement of registration with the gasholder.

43. To save time with small meters it is a good plan to have a few platinum or steatite jets with orifices of such size as to allow about half-a-cubic foot of gas to pass per hour under a three-inch pressure. These burners if mounted on short stems or pillars provided with cocks, can be affixed to the outlets of the meters, and the adjustment to the required rate per hour quickly made. The gas passing from larger meters must be consumed at the float, as the heat given out would affect the temperature near the holders.

TEST FOR PER-CENTAGE.—FAST.

44. Having determined the soundness of the meter, turn off the gas, and, if the same holder be used, replace as many of the weights as will reduce the pressure to half-an-inch. If the meter be a wet one remove the outlet connection of meter and take out the charge and syphon plugs; if any water flow out, add more, and allow the excess to drain off. Replace the outlet connection and open some of the burners (48); turn on the gas and adjust the cocks until the meter is working at its proper rate per hour.* Observe the index drum (32), and as soon as a figured division is brought directly under the pointer, turn off the gas. Refill the holder to the zero point, and then pass gas through the meter until the index drum has made an entire revolution and the division started from is again brought under the pointer, shut off the gas and read on the gasholder scale how much gas has been used. As, in almost every case, a quantity more or less than an

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* The regulation of speed must in all cases be made by adjustment of the cocks *beyond the outlet* of the meter, and not by the gasholder cock. It is for the purpose of adjustment of speed that the cock is placed on the air outlet, there being no float of lights on the air side.

exact number of cubic feet will be used from the holder, while the meter will always record an exact number of cubic feet, it follows that the per-centage of error can only be arrived at by a proportion.*

45. Thus, if the gasholder reading be 99 cubic feet, and the meter record 100, the per-centage of error will be 1·01 per cent. fast—

99 : 100 : : 1 : 1·01.

If the registration of the meter does not exceed 2 per centum fast, or in favour of the seller, it is correct within the meaning of the Act, and if it be a dry meter must be stamped, but if it be a wet meter it must then be submitted to the—

TEST FOR PER-CENTAGE—SLOW.

46. With gasholder turned on, with connections still on the inlet and outlet, and with *one* or *more burners open*, draw off sufficient water by syphoning from the charge ring, or by tilting, to bring the float down, and thereby close the inlet valve. Restore the meter if it has been tilted to its horizontal position, and apply a light to the burner to determine that no gas is passing. Next, with gas still turned on, pour water very gently into the meter, tapping the meter with the finger the while, until the float rises and allows gas to pass freely. Care must be taken not to add more water than is absolutely necessary to lift the float, and it is to assist the rising of the latter that the tapping is recommended. While performing this operation, a small flame should be applied to the float burners, so that the instant the gas passes it may become apparent from its ignition.

47. Now take starting points on the index drum (32) and on the gasholder scale, as in the former test, and register. If the

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* To save trouble in making calculations, a Table, extracted from a more extended one, compiled and printed by the authority of the Board of Works for the use of their inspectors, showing the per-centages on various quantities, is given at the end of the book.

meter be not more than 3 per cent. slow, it will be correct within the meaning of the Act, and must be stamped.

48. When testing large meters do not attempt to burn all the gas, as great heat would be given out, but open, or partly open, the large cock on the float of lights, so as to permit a portion to escape unconsumed into the chimney.

49. In the foregoing the process of testing with *gas* has been explained. Air can, however, be used without difficulty in the test for per-centage of error *fast*, but not so easily in the test percentage of error *slow*, except when the measuring wheel is visible through the outlet of the meter. In such cases proceed as follows :—After drawing off water, remove the outlet connection from the meter and *nearly cover* the outlet union with a small piece of glass. Turn on the air, pour in water, and gently tap, as before directed; while doing so look through the glass down upon the measuring wheel, and, as soon as this is observed to move, cease to add water; replace outlet connections and proceed to register as with gas.

CORRECTIONS FOR TEMPERATURE.

50. There is both trouble and uncertainty in the making of corrections, when gas or air changes its temperature in its passage from the holder through a meter, and it is advisable to use every possible care to maintain the testing room, the water in the gas-holder tanks, and the water with which wet meters are charged, at the same temperature. Such care will demand less trouble while it will ensure greater accuracy than is possible with calculated corrections.

51. It is usual to assume that the temperature of the gas or air at the outlet of the meter represents the temperature at which the gas or air has exerted its effect in working the meter. It has been suggested to the writer, that it is doubtful whether this is the case, inasmuch as such assumption is based on the idea that the change in temperature is instantaneous. The experiments of

the writer tend to prove that the change is really so promptly effected that the outlet temperature may be fairly taken to represent the temperature within the meter.

52. The following table by the Astronomer Royal, published in Parliamentary Paper No. 339, Session 1861, shows the dilatation of gas in contact with water, and saturated with aqueous vapour for given temperatures.

NOTE.—*The Table shows the per-centage of increase of the volume of gas above its volume at the temperature of* 31·4° *of Fahrenheit.*

Temperature in Fahrenheit's Scale.	Per-centage of Dilatation.	Temperature in Fahrenheit's Scale.	Per-centage of Dilatation.	Temperature in Fahrenheit's Scale.	Per-centage of Dilatation.
31·40	0	54·33	5½	74·30	11
33·54	½	56·24	6	75·94	11½
35·70	1	58·12	6½	77·23	12
37·84	1½	60·02	7	78·81	12½
39·91	2	62·00	7½	80·40	13
42·05	2½	63·77	8	81·94	13½
44·17	3	65·63	8½	83·44	14
46·22	3½	67·43	9	84·88	14½
48·25	4	69·18	9½	86·39	15
50·32	4½	70·90	10	87·83	15½
52·36	5	72·60	10½	89·20	16

53. During the passage of gas, its temperature as shown by the thermometer on the outlet of the holder and that on the outlet pipe from the meter must be carefully observed, and if any change in its temperature takes place, then, before determining the percentage of error of the meter, correction of volume must be made.

Rules for making corrections for the increase or decrease in volume caused by change of temperature.

54. With the gas issuing from the meter at a ***higher*** temperature *than from the gasholder.*

Rule 1.—Calculate the per-centage of increased volume on the quantity indicated by the gasholder, and add it to the gasholder's indication.

Example.—Temperature outlet of holder, 54·33°.
Temperature outlet of meter, 72·6°.
Per-centage of difference in volume by table, 5 per cent.
Gasholder reading, 95 feet.
Five per cent. on 95=4·75, which added to 95=99·75 cubic feet, or the volume of gas passed through meter.

With the gas issuing from the meter at a *lower* temperature than from the gasholder.

55. **Rule** 2.—Calculate the percentage of contraction on the quantity indicated by the meter, and deduct the result from the volume indicated by the gasholder.

Example.—Temperature outlet of gasholder, 70·9°.
Temperature outlet of meter, 52·36°.
Per-centage of difference by table, 5 per cent.
Reading of meter, 100 feet.
Reading of gasholder, 107 feet.
Five per cent on meter reading=5 feet and 107–5=102, or the volume of gas passed through meter.

56. In the first instance, the 95 feet from the gasholder will have expanded 5 per cent. or to 99·75 cubic feet. It follows that the meter will have been worked to the same extent as if at equal temperatures 99·75 cubic feet had passed from the gasholder. It is, therefore, manifestly proper to add the per-centage of increase to the scale reading of the gasholder, and incorrect to deduct it from the index reading of meter.

Example.—Correct method, 95+4·75 : 100 : : 100 : 100·25.
Incorrect method, 95 : 100–4·75 : : 100 : 100·265.

57. In the second instance the 107 cubic feet from the holder will have decreased in volume and have produced a proportionately diminished effect in working the meter. It is, therefore, manifestly proper to deduct the per-centage of decrease from the gasholder reading, and improper to add it to the meter reading.

Example.—Let the reduction be equal to 5 cubic feet.
Correct method, 107–5 : 100 : : 100 : 98·03.
Incorrect method, 107 : 100+5 : : 100 : 98·13.

58. The correctness of calculating the per-centage of reduction

on the volume of the gas of lowest temperature will appear from the following considerations. The Astronomer Royal's table shows that 100 volumes of gas, saturated with aqueous vapour, when heated from 31·4° to 89·2°, expand to 116 volumes or to the extent of 16 per cent.; and also that 116 volumes of gas, saturated with aqueous vapour, when cooled from 89·2° to 31·4°, contract to 100 or to the extent of 13·796 nearly per cent. If, therefore, the per-centage of reduction were calculated by the figures of table on the gas of highest temperature, then if the temperatures were as in the table 89·2° and 31·4°, the result would be wrong to the extent of the difference between 16 and 13·796 or 2·204 per cent., and so in varying proportions between other temperatures.

59. The foregoing rules, although not quite perfect, give results sufficiently accurate for practical purposes with meters whose errors of registration are within the limits prescribed by the Act of Parliament, and when but slight differences of temperature exist, say from 1 to 4 degrees, or not exceeding 1 per cent. of difference of volume. The imperfections arise from the following circumstances. The Astronomer Royal's table exhibits the per-centage of dilatation on the original volume of gas at 31·4° Fahrenheit. Thus, at 62·02°, the original 100 volumes have expanded to 107, and at 62° to 107½, or to the additional extent of ½ per cent. on the original volume at 31·4°. By the rules the per-centage of correction is taken to be equal to the difference in volume at 60·02° and 62°, or ½ per cent. calculated on the volume of gas used at temperature 60·02°, which is erroneous; for if 107 volumes at 60·02° only expand to 107·5 at 62°, it is evident that the increase must be something less than ½ per cent., for this would give the volume at 60° as 107·535 instead of 107·5. If the true per-centage of increase is required, it must be found by proportion.

Volume of Gas by table at 60·02°	Volume of Gas at 31·4°	Per-centage of dilatation of the original volume from 60·02° to 62°	Per-centage of dilatation of the volume at 60·02° from 60·02° to 62°
107 :	100	·5	·4673.

The difference in the above instance is not very important, but suppose the temperatures to be 60·02° and 70·9°, which by table would give 3 per cent.

107 : 100 : : 3 : 2·8037.

and cause an error of ⅕ per cent. nearly.

If the meter be slow, it will require *more*, and if fast, *less* than 100 cubic feet of gas to pass through to make it register 100 feet. By the second rule the per-centage of reduction in volume is calculated only on the quantity recorded by the meter. If for special purposes the true per-centage is required, it must be found by proportion, and taken on the volume of gas at highest temperature.

Example.—Temperature outlet of gasholder, 63·77°.
Temperature outlet of meter, 60·02°.
Per-centage of difference by table, 1 per cent.

Volume of Gas by table at 63·77°		Volume of Gas by table at 31·4°		Per-centage of difference by table between 63·77° and 60·02°		Per-centage of contraction from 63·77° to 60·02°
108	:	100	: :	1	:	·92.

Gasholder reading at 63·77°, 106 cubic feet. ·92 per cent. on 106 = ·975 and 106—·975 = 105.025, or the correct gasholder reading for temperature 60·02°.

THE TEST-METER,

AND THE MODE OF USING IT.

60. The writer has been for years an advocate for the use of *test-meters* by inspectors, and in former editions of this treatise expressed his hope and his belief that the law would be altered so as to permit their use. In the last edition it was remarked, "that " such meters would be of the greatest utility for testing large " meters which are fixed and in use at public buildings, factories, " &c., which meters cannot be removed to the inspector's office, " except with great difficulty and expense." The writer has, at last, the satisfaction of seeing *test-meters* included among the standards of the Board of Trade, and rendered legal secondary standards by an Order in Council, dated the 24th March, 1871.

The government authorities are now prepared to verify test-meters, and it only remains for gas meter inspectors and others to avail themselves of the advantages which, for special purposes, the use of these meters afford.

61. It should be mentioned that these secondary standards include meters of the *dry* as well as of the *wet kind*, and the writer cannot but think that the Royal Commissioneers on Weights and Measures made a very serious mistake in recommending the adoption of the *dry* meter as one of the secondary standards; certain it is that no inspector who possesses any practical knowledge of meters would think of using a dry meter for testing purposes, even if such meters were likely to stand the process of verification at the Standards Department. The most material reasons against the dry meter and in favour of the wet, for ***testing purposes***, are as follows, and these reasons were submitted by the author to the warden of the standards in July, 1870 :—

62. *Dry Meter.—Reasons against.*—The measuring-chambers are composed partly of flexible material; and measurement is, moreover, dependent on the preservation, under all conditions of use, of the absolute soundness of the slide-valves, by which gas or air enters into, and is discharged from the measuring-chambers. The dry meter is subject to disturbing influences, which alter its measuring capacity, and the existence of such disturbing influences could not be known at the time of using the meter, or even before or afterwards. The meter might, under conditions apparently identical, or at all events under conditions in which an inspector could use it, vary to the extent of 2 or 3 per cent., and the inspector know nothing of such variation. No means can be devised which will enable a dry meter to give internal or external evidence, of its measuring condition, and therefore it would become necessary, if the dry meter were used for testing purposes, to reverify it at frequent intervals.

63. *Wet Meter—Reasons for.*—The measuring-wheel of a wet meter is composed of inflexible material, and is practically incapable ***of any variation*** in capacity, except that produced by the elevation

or depression of the water level. The measurement is, moreover, independent of any valves whatever. It is free from any influences capable of disturbing its measurement when used under conditions which the inspector can command and control. It affords internal evidence of its own measuring condition, for the wheel being inflexible and unchangeable as to dimensions, and the depth of its immersion being defined by lines upon water-level gauges, it follows that it is only necessary to charge the meter, on every occasion of using, to the lines on the gauges, to secure optical evidence of the meter's measuring condition; hence retesting at frequent intervals is unnecessary.

64. The standard test-meters are respectively 20-light and 100-light size, those of the wet kind, fig. 7, having been made under the direction of the writer in accordance with a design submitted by him to the Royal Commissioners. The measuring wheels of these meters are made of very stout incorrodible metal, and the cases are lined with the same metal one-eighth of an inch thick, so that the meters are as durable as the other Government standards which relate to gas measurement. The meters are of 20-light and 100-light sizes, and each is provided with *three* water level gauges, and with adjusting screws in the feet, so that it can be set to a true level with the utmost facility. One of the gauges is also so arranged that the outlet gas pressure may be allowed to act within it, through the cock A' or the inlet gas pressure through the pipe and cock C

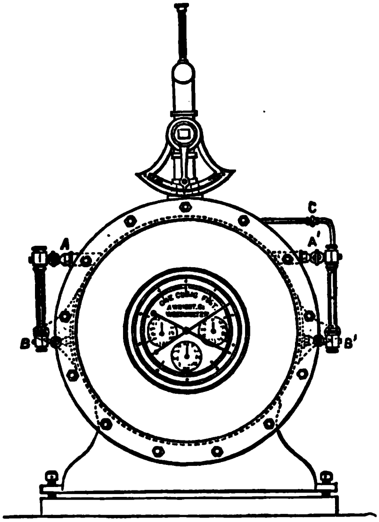


Fig. 7.

thus enabling the operator to adjust the water line, either when the meter is at rest or when it is in action. (75 to 77.) The index of each meter is centrally placed, and its dial is circular. The indications of quantity range from $\frac{1^{\text{th}}}{100}$ of a cubic foot up to 1000 cubic feet, and the pointers can be shifted backwards and thus set at zero without the necessity for working the meter, or of stopping the passage of gas through it if the meter be in action.

65. Each meter is also provided with a nosepiece union on its inlet for the attachment of tube, and its outlet is surmounted by a bend, also terminating in a nosepiece. A thermometer is inserted in a socket on the bend, so that the temperature of the issuing gas may be readily observed, while the rate of issue is controlled by a cock, furnished with an index, so that after having been closed, the cock may be readily reopened to the desired extent. (76.)

66. The extreme dimensions of the meters are—

20-Light		100-Light	
Diameter .	2′ 2″	Diameter .	3′ 8″
Depth .	1 6	Depth . .	2 6
Height . .	2 2	Height. . .	3 8

the 100-Lt. having been made at the suggestion of Mr. Airey, one of the Board of Works Inspectors, less in depth than usual, so as to be readily conveyed through narrow passages and doorways.

67. Test meters should generally, in their construction and details, agree with those just described, but need not by any means be so elaborately finished and expensive.

69. The special advantages possessed by a test-meter are its moderate dimensions, and the consequent facility with which it can be transported to, and deposited for use in, places where a gasholder is inadmissible; the ease with which it may be used; and the greater accuracy in the results over those obtainable by the employment of a gasholder under necessarily exceptional conditions. With the latter it is impossible to maintain a continuous discharge of gas or of air through a large meter. (24.) It is to be distinctly understood, that a test-meter can never be accepted and employed as an efficient substitute for the gasholder in the offices of meter inspectors, of meter makers, or of

gas companies, inasmuch as it is incapable of adjustments which would cause it to deliver gas at different and specific pressures; for although it would be easy to provide means for such adjustments by the application of a water-wheel, of clockwork, or of a pulley and weight, in connection with the shaft of the measuring wheel, such application is certainly objectionable and would interfere with measurement. Hence, with a test-meter, it is not possible to test another meter under any specified conditions as to pressure of gas; but this fact affords no basis upon which objections can be raised to the employment of test-meters for the purpose advocated.

70. In order to demonstrate the accuracy with which a meter may be tested by another of smaller size, the following experiments were made:—

(*a*) A small wet meter was most carefully tested by discharging through it, at the exact rate due to its capacity, the entire quantity of air which a gasholder contained within the limits defined by its scale. *The meter was found to agree exactly in measurement with the gasholder.*

(*b*) The meter was then connected to a meter of ten times greater measuring capacity, and of precisely the same construction as a station-meter, but without an overflow water-gauge. The water-line being defined by a socket opening, and the water-level being adjusted when the meter was out of action. Gas was then passed through both meters in a continuous flow, at the precise rate at which the smaller meter had been tested, until the measuring-wheel of the larger meter had made several revolutions, as indicated by the index. *The registration of the meters was found to be in perfect agreement.*

(*c*) The larger meter was then tested at the rate due to the small meter, and with the same holder which had been used to test the small meter, and *was found to agree exactly in measurement.*

(*d*) The larger meter was then tested with the same holder at higher rates of working, and it slightly and regularly altered in its registration, until, on being worked at its proper speed, and when therefore delivering its proper quantity of gas, the change amounted to the *insignificant* error of *one per cent. slow.*

71. The greatest possible care was taken in these experiments, which were many times consecutively repeated, to preserve equality of temperature in the water, in the gasholder and meters, and in the air employed.

72. With such facts as the above before his eyes—facts which the writer has repeatedly verified—with a knowledge of the manner in which inspectors use, and are *obliged* to use, gasholders for testing large meters which are *away* from the testing offices, and with the experience of years in the use of the test-meter, the writer is forced to entertain a firm conviction that accuracy is only to be attained, on most occasions, by the use of a test-meter for out of office work, and feels justified in advocating in the strongest terms the employment of a test-meter for such work, and for the purpose of determining the accuracy of large meters generally.

73. As shown in the experiment on the larger meter above mentioned, a wet meter becomes *slow* to a certain limited degree when worked *above* the speed at which its measuring capacity has been determined.

74. The reverse of this takes place when a meter is worked *below* its speed, and it becomes *fast* to a trifling extent.

75. The reasons for such variations are as follows :—A meter requires power to drive it; this power must be derived from the gas to be measured, so that the gas must be delivered into and pass through the measuring chambers under some sensible pressure, *i.e.*, in a state of compression greater than that of the atmosphere, and can only be measured while in this greater state of compression. The practical effect of this compression is very small (see end para. 7), but sensible and important differences in measurement arise from the displacement of water from the measuring chambers, which displacement increases as the working speed is increased, owing to the increased resistance of the wheel, *and renders* the meter *slow*, that is, causes it to register *less* than *the true volume* passed through it. This fact leads to an important

oposition—viz., What are the conditions under which a *test* or *ndard wet meter* must be employed, in order to secure the closest pproximation to true measurement?

76. If the capacity of the meter has been determined at its ormal rate of working, and the water-level defined by marking he gauges when the meter is not working, and when only the tmospheric pressure is acting within it, then the meter must lways be *charged* with water to the indicated level *when open to he atmosphere;* and it must always be used at its *normal rate* of orking, or, if worked at other rates, the *per centage of error due o such rates* must be *experimentally determined and allowed for.* Practically, the error due to varying rates is not likely to exceed bout *one per cent.*

77. If the capacity of the meter be determined at its normal r at any rate of working, and the water-line be defined while the eter is *working* at the same speed, and the pressure of the *inlet as* be acting in the gauges, then the meter can be made to measure correctly at any speed, by the simple process of adjusting the water-line while the meter is working at the rate desired. More water will necessarily be needed in a meter when worked at a high speed, in order to provide for the difference in the levels within and without the wheel.

METERS WHICH MAY BE VERIFIED BY A TEST-METER.

78. It may sometimes happen that large meters, such as are mentioned in the 27th and following paragraphs, may have to be verified by the aid of a *test-meter*, and in such cases the general instructions previously given in respect to such meters must be adhered to, except that it may be impossible to put them under the 3-inch pressure test for soundness or to work them at full speed. Generally, however, the kind of meter which demands the use of the *test-meter* is that which is designated in the trade as a *station meter*, simply because it is in form and construction similar or identical with those employed on gas works.

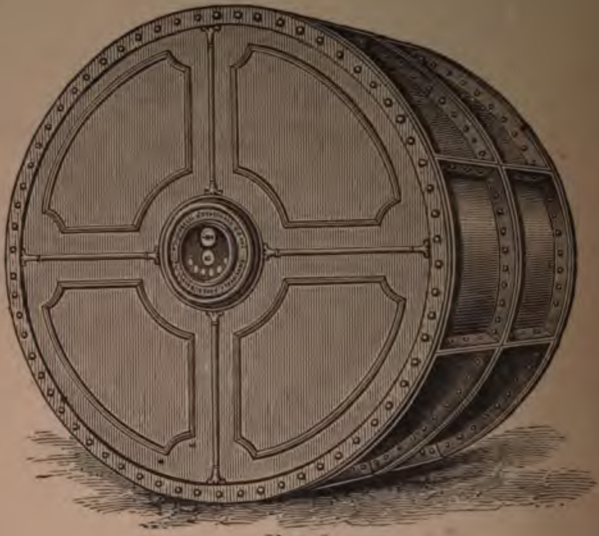
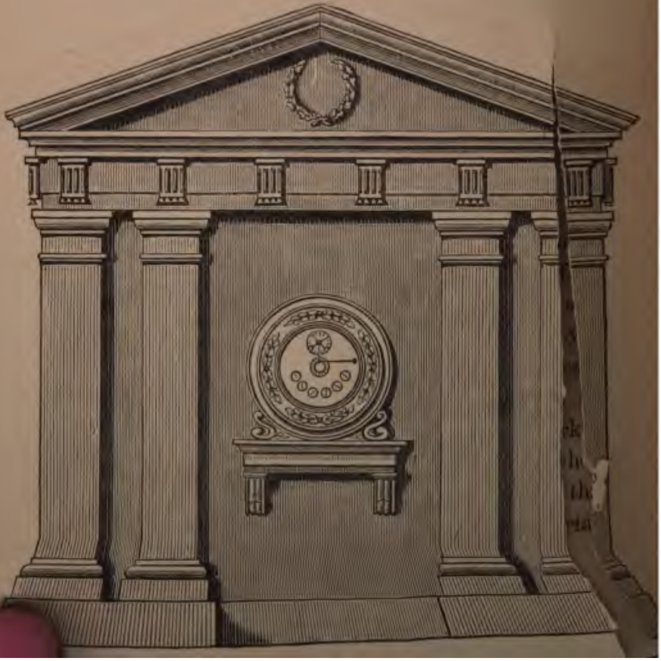


FIG. 8.



79. A station meter may, as to its case, be a simple cast-iron cylinder, or a segmental cylinder (fig. 8), or a rectangular plain or ornamental cast-iron tank (figs. 9, 10), and the measuring capacity of its wheel may range from 5 feet per revolution up to 1,000, or even, perhaps, 2,000 cubic feet, although none *so large* as the latter capacity have been yet erected.

80. With all station-meters the *index* is placed in the centre of the front, and the gas-inlet is in the centre of the back, the gas outlet is also at the back and on one side of the inlet. Both the inlet and outlet openings are fitted with flanges for the attachment of the main pipes. The water-level of the meter is indicated on a gauge, similar to a boiler-gauge, affixed to the meter case, the glass tube of the gauge being protected by a sheath or other con-

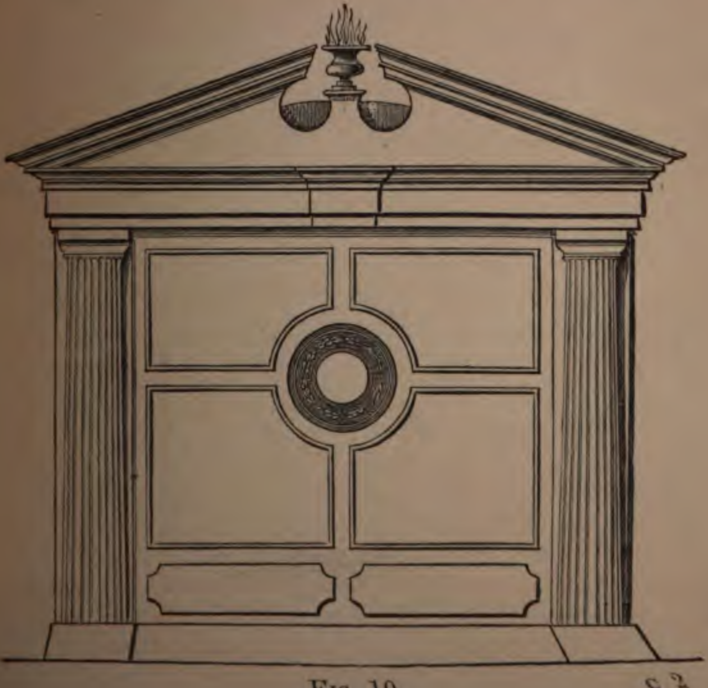


Fig. 10.

trivance bearing the makers number of the meter and the water level mark or indicator. This sheath or contrivance should be stamped by the Inspector when such a meter is tested. Sometimes this gauge is so affixed to the meter as to be acted upon by the outlet pressure, it then shows the dead level of the water, *i.e.*, the level when the meter is not working, but it is better to connect the gauge to the inlet, so that it is acted on by the inlet pressure of the gas as in fig. 11, where the pipe P is supposed to connect the gauge with the inlet, for a consideration of the conditions under which a meter measures gas (77), shows clearly that *all meters to which gauges are affixed to indicate the water-level should have the water-line defined while the meter is in motion.* The advantages are, that an Inspector may test a wet meter at any convenient or possible rate of speed, marking the "working line" while it was in action, disconnect his testing apparatus, set the tested meter in full action, and then add the needful quantity of water to make it measure correctly. Further, an inspection of the water-line when the meter is in full action will at once show whether it is properly charged. The increased accuracy of registration on this system would in many instances amount possibly to 2 per cent. On the usual system the gas must be *shut off* from the meter before the water-level can be adjusted, causing at times much trouble and inconvenience.

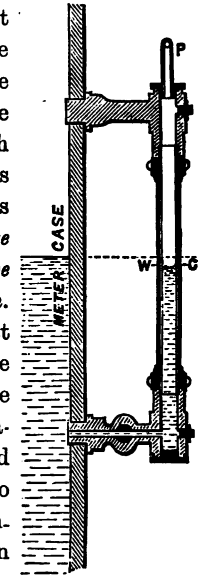


FIG. 11.

81. Some meters are provided with a gauge similar in construction to that shown in fig. 12. B is a box, rectangular or cylindrical in shape, attached to the meter case, and in communication with the interior thereof at a point below X, the water-line of the meter. P is a pipe connecting the box with the inlet of the meter, *so that the inlet* pressure of the gas may act within the box. O

is a vertical pipe screwed through the bottom of the box, and rising therein to the needful height for its top to coincide with the water-level. The bottom of O is sealed in a lute from which a pipe extends to a sink or drain. A meter which is provided with such a gauge as this cannot be overcharged with water, for any excess which may be run into the meter at once flows away through O. It is usual with large station meters in gas works to keep a constant stream of water flowing into the meter, for the purpose of maintaining the water-level within the measuring wheel as equable as possible under varying rates of speed (77), and also for the purpose of keeping the water in the meter in as clean a condition as possible. The box being subject to the inlet pressure, and the top of the pipe O coinciding with the line of true measurement within the wheel, it will be apparent that when the working speed of the meter is increased, the incoming water soon restores the true level, and that when the working speed slackens the increased rapidity of the outflow soon disposes of any excess.

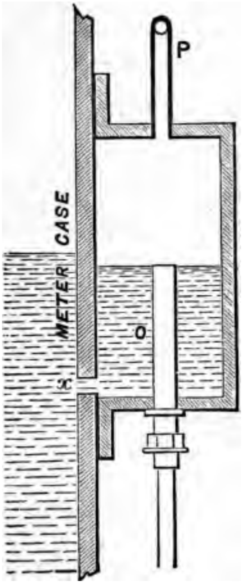


FIG. 12.

82. Another form of water-level gauge is shown in fig. 13. This form was devised by Mr. Mills, Meter Inspector of the Metropolitan Board of Works, at Westminster. It serves simply as a seal box, and is acted on by the outlet gas through the hole G, the water entering the box from the water-case through the lower hole. The pipe P is cut to the water line, and the water flows into C, thence through the channels D, E, into the outer chamber F, and out at the spout. The advantage of this box is that an excess of water

cannot be run off or syphoned out from F, for, although it may be syphoned from E F, yet, as the water column is broken above E, the channels D C remain charged, thereby preserving the true level and preventing the escape of gas.

There are several other forms of overflow water-level gauges, but those which have been described embrace the principles on which all are constructed.

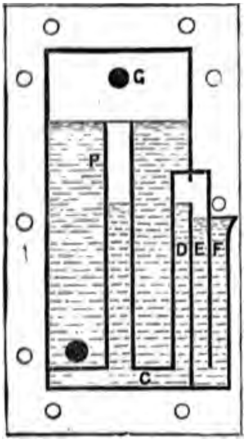


Fig. 13.

TO PREPARE THE TEST-METER FOR USE.

83. Place the test-meter on a tolerably level and firm stand or board, as in fig. 7, as near to the meter to be tested as may be convenient. Open the cocks, A, A', B, B', of all the gauges. Insert a funnel into the charge-socket on the top of the test-meter, and pour in water until it reaches so nearly to the water-line indicators of the gauges that it can been seen whether the meter stands level. If necessary adjust it to a perfect level by the aid of the screws in its feet. Add more water until in *each* gauge the lowest part of the meniscus or cup formed by the water coincides with the water indicator. If too much water be put in, the excess must be drawn out through the cock in the lower part of the meter case. Insert the thermometer in its socket (65), and the meter is ready for use.

84. If the meter is to be used *at* or *below* its nominal rate of working (120 cubic feet per hour, or 2 cubic feet per minute for a 20 light, and 600 cubic feet per hour, or 10 cubic feet per minute *for a 100-light,* the cocks A A, B B, of all the gauges must be

open, and the cock C, on tube connecting the back guage to the inlet, must be closed,* but if the meter is to be worked *faster* than its normal speed, close the cock A of the back gauge and open C, and while the meter is working at the speed desired (76,77) add more water until the level in the *back gauge* coincides with the "working level." This addition of water can easily be made through a seal or syphon-funnel, *screwed* into the charge socket of the meter; or better, the meter may be made with an elbow joint near its base to receive an upright pipe with a funnel on the top, after the manner which is usual with station meters. (W. fig. 14.)

85. A little practice is needful to make an adjustment of the level while the meter is working, owing to the oscillation of the water, but there is no practical difficulty, and a 100-light may be so adjusted in a very few minutes. The true line is fixed upon by observing that the range of oscillation is equal on each side, that is, above and below the working line.

86. As a rule, it will be found most convenient to adjust the water-level when the meter is not in action, and then to work it near to its normal speed. As is shown in paragraph 70, *et seq*, a considerable variation in the rate of speed is needful to induce an error of one per cent. Some experiments with a 20-light test-meter of A. Wright & Co's. manufacture, showed that when it was worked at half speed (60 ft. per hour) it registered $\frac{1}{4}$th per cent. *more*, and when worked at double speed (240 feet per hour) $\frac{1}{5}$th per cent. *less* gas than it delivered. The difference in a 100-light would no doubt be nearly or quite *half* per cent. each way.

TESTING OPERATIONS.

87. There are three conditions under which a meter may be presented for verification by the aid of a test-meter.

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* Take great care *not* to have A and C of the back gauge open together or gas will pass from the inlet into the case, and thence unmeasured from the outlet of the meter.

1. **Fixed in position for use, complete with service pipes, but having had no gas delivered into it.**
2. **Fixed and in actual use.**
3. **Unfixed and standing in a yard or shop.**

88. Dealing with the first condition, and assuming that it is a station-meter which is to be tested, the following description of the diagram, fig. 14, and the accompanying remarks will render the arrangement intelligible. A represents the back of the *test-meter*, B the back of the *station-meter* to be tested, C is the inlet pipe of the latter with a valve at D. The outlet pipe is E, having a valve at F, while G is another valve to serve as a bye-pass. All these valves are supposed to be, and must be, *closed* when the test is made. H is a pipe connecting the *inlet* pipe, *below* the valve D, to the *inlet* of the test-meter, but the gas may, of course, be obtained from any other convenient source of supply. K is a pipe connecting the *outlet* of the test-meter to the *inlet* of the station-meter at a point *above* the valve D. The pipes H, K, may be of metal or vulcanized rubber, the latter kind of tube, if of the best quality, is quite reliable and is the most convenient to apply in the majority of cases. L is a pipe, provided with a main cock, extending to any safe point for the discharge of the gas. If the meter be in the open air the pipe is not needed, but the cock may be screwed into the upper part of E. M is an overflow water-box, similar to that shown in fig. 12, while P is a pressure gauge on the pipe connecting M to the inlet of the meter. N is a water-level gauge, similar to that represented in fig. 11, but subject, as is also the attached gauge P, to the pressure of the outlet gas. T T are thermometers inserted in the respective outlets of the two meters. W is a pipe by which water is delivered into the station-meter at a point near to its base, while Y is a main cock by which the water may be wholly discharged from the meter when needful. The station-meter may be charged with water to the heights indicated on the gauges through the pipe W, or from a water service-pipe attached to the cock Y, or in any *other convenient* way, it must, however, be observed that while

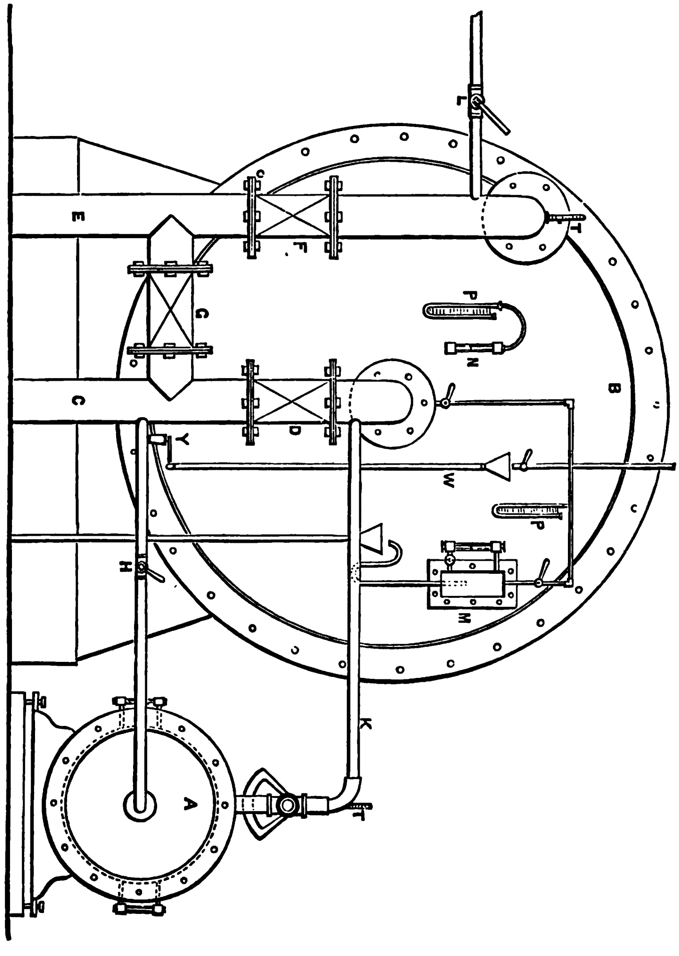

Fig. 14.

being so charged the meter must be in communication with the atmosphere, through L, or some other point. The author is of opinion that every station-meter should be verified by an experimental determination of the capacity of its measuring drum (see note †, p. 43). Hence, whenever it is possible, his practice is to remove the index, attach a stout wire, by a screw or by soldering, to the key-wheel (which in A. Wright & Co.'s meters is always in the centre of the index pot), so that the free end of the wire projects a little beyond the edge of the index pot. A simple pencil or fine chalk mark serving as the starting (and stopping) point. The accuracy of the index train may be determined by calculation after counting the number of teeth in each wheel and pinion, and also by a final revolution or two of the drum after the index is refitted.

TEST FOR SOUNDNESS.

89. Pass gas through both meters until the whole or the greater part of the air is expelled from them. During this operation adjust the speed of the test meter by its outlet cock to the rate desired (86), and note the extent to which the cock is opened.

90. Close the cock L and as soon as the gas in both meters is compressed to the extent due to the acting pressure, the index of the test-meter should remain motionless. If it continues so for the space of a few minutes, the station-meter and its connections may be considered sound, but if any movement takes place, *leaks* must be sought for in the connections and about the meter case, by the aid of the *sense of smell alone;* unless the leak be *very trifling and the meter has had gas passing through it for a long time,* or sufficiently long to cause the measuring wheel to make several revolutions, for the application of a flame might lead to an *explosion,* which would be of *so serious* a nature with a large meter, that the slightest risk of it should be scrupulously avoided. Of course no danger of an explosion will ensue from the application of a light *to a small hole in a* **meter which has had gas, and gas only, passing**

through it for a long time, if the inlet opening be much larger than the outlet, and the gas be supplied under a good pressure, but in testing it is most convenient generally to reduce the inlet to the large meter by the test-meter cock, as stated in the last paragraph. Sometimes the leaks may be discovered by the bubbles produced when fluid paint, water, or other liquid is brushed over the joints and connections.

REGISTRATION TEST.

91. When the meter and connections have been proved to be gas-tight, the test for registration may be made in one of the following ways. The first being usual, but far less reliable than the second.*

92. *First Method.* Pass gas through the meters until the temporary pointer (see end of para. 88) reaches a pencil or other mark made on the edge of the index pot, or the index an exact quantity, as 100 feet, 110 feet, 1,000 feet, and so on, then close the cock of the test-meter and set its index (by turning the large hand backwards) to zero, re-open the test-meter cock to the required extent (86), and allow the gas to flow until the pointer or index of the station-meter shows that at least two revolutions of its measuring wheel have been made †, then instantly close the cock of the test-meter. Alter the water level within the station-meter and retest as many times as may be needful until it agrees with the test-meter.

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* The writer has repeatedly, when verifying large station-meters, tried both methods, and feels confidence only in the second, for although theoretical considerations, of which one is mentioned in paragraph 75, are insufficient to account for discrepancies, it is an actual fact that with the first method, very troublesome discrepancies do arise. It may be that these are in part due to the gearing of the indicating apparatus, which, in the second method, must be in close connection and perfect action.

† It is recommended to verify meters by the revolution of their measuring drums drums or wheels, and not by the revolution of the pointer index. There is scarcely a meter drum made in which the four chambers are *exactly* of the same cubic capacity, and the larger the drum the greater is the inequality likely to be. Hence its capacity can only be determined by one or more complete revolutions. Suppose the first dial of index show 100 cubic feet, and the capacity of the drum be 30 cubic feet, the drum must make in theory 3⅓ revolutions to effect the revolution of the pointer, and although the measurement might appear right for the first 100 cubic feet, it might appear wrong for the second, and only right again on the third.

93. *Second Method.* Close the cock L; open the the test-meter cock to the required extent (86). The gas will enter both meters. Set the test-meter to zero or nearly so. Make a mark for a zero point a little in advance of the temporary pointer of the station-meter, or fix upon some figure on its dial in advance of the dial-pointer, and note what the index registration will be when the figure fixed upon is reached. Open the cock L. Both meters will commence working. Observe the test-meter index, and note its registration the instant an assistant gives a signal that the index or pointer of the station-meter has reached the figure or mark fixed upon. Continue the flow of gas until the assistant signals the completion of a revolution of the station-meter, and then instantly close the cock of the test-meter, and note the index of the latter, the difference between the first and last readings of the temperature within both meters be the same, equals the capacity of the station-meter at the existing water-line.

Ex. Test Meter index at the end of the test	55·3
„ „ „ commencement „	4·4
Capacity of Station Meter	50·9

Showing its water-line to be low, and its registration *slow* to the extent of 1·77 per cent. (see per centage table).

94. If the temperature of the gas at the outlets of the two meters differs, the indicated volume must be corrected, and the calculation can only be conveniently made on the volume indicated by the test-meter.

> Rule.—Calculate the difference in the volume of gas due to change of temperature (see table p. 24). Add the difference to the indication of the test-meter if the gas issues from the station-meter at the *highest* temperature. Deduct the difference from the indication of the test-meter if the gas-issues from the station-meter at the *lowest* temperature.

it occasions it will be quite near enough to assume within a range of temperature from 50·32° to 69·18° that 4 degrees produce one per cent. difference in volume.

Ex. Gas outlet Station Meter	65°
„ „ Test Meter	61°
Difference	4°

Ex. Gas outlet Test Meter	58
„ „ Station „	54
Difference	4°

One per cent. on 50·9 is ·509, and this has in the first example to be added, making 51·409 as the capacity of the station-meter. In the second case it has to be deducted, leaving 50·391 as the capacity.

95. When a meter is fixed and has been at work for some time it will be fair to assume that the connections are sound; hence, unless there are special reasons to the contrary, the "soundness test" may be omitted, and the test-meter may be attached to a pipe from the outlet of the station-meter, so that the gas shall first pass through the latter meter. The verification should be made after the manner described in paragraphs 88 *et seq.* the flow of the gas being wholly controlled by the test-meter cock, instead of being so in part by the cock L, fig. 14.

96 If a meter has to be verified under the *third* condition (87) adjust it to a perfect level by the aid of wedges, blocks, or other convenient means. Be careful also that the meter stands upright, that is to say, that the centre line indicated by punch or other marks on the front plate is vertical, this must be determined by the aid of a plumb line. Next charge the meter with water of, as nearly as possible, the same temperature as the surrounding atmosphere. Close the inlet of the meter (making a perfectly sound joint with yarn and lead putty) with a blank flange provided in its centre with a short nosepiece of 1 or 1½ pipe. Close the outlet in the same way, but the blank flange must be provided with a cock answering to L fig. 14, and with a socket to receive a

thermometer. Place the test meter near to the meter to be tested, and proceed as directed in paragraphs 89, &c.

VERIFICATION OF DRY METERS WITH A WET TEST METER.

97. In the verification of large dry meters the test meter should generally be applied to the outlet. The internal soundness of the dry meter can in this way only be determined by passing gas at a low rate for some time and noting the indications of both indexes. If these agree the verification may be proceeded with.

FORMS OF BOOKS, CERTIFICATES, &c.

98. The two principal books required are the "Testing Room Book" and the "Receipt and Delivery Book." Convenient forms for these will be found appended, with examples of the mode of filling up.

99. An ordinary cash-book should also be had, and the fees entered on the debit side therein from the "Receipt and Delivery Book." On the credit side of the cash-book will be entered the sums, with the dates when paid over by the inspector to the proper authorities.

100. When meters are delivered the inspector should require a "Delivery Note" with them and give a "Receipt Note" in return. This will prevent mistakes, as the delivery notes can be filed, and the particulars of the meters entered from them into the books at convenience. When the parties come for their meters they must, of course, give up their receipt notes. A form of receipt will be found at the end. The delivery note is merely a copy of this. Both copies are filled up by the parties who bring the meters to be tested.

101. Certificates of the registration of meters must be given when demanded, as stated in clause 9 of the Act. A form of *certificate will also be* found appended.

PER-CENTAGE TABLES.

Showing the *per-centage of error* in meters whose registration differs from the indications of the test gasholders.

Extracted from an extended table, compiled and printed by order of the Metropolitan Board of Works, for the use of their meter inspectors.

+ signifies *Fast.*
— „ *Slow.*

Meter Registering 2 feet.		Meter Registering 5 feet.		Meter Registering 5 feet.		Meter Registering 5 feet.	
Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.
Feet.	Per Cent.	Feet.	Per Cent.	Feet.	Per Cent.	Feet.	Per Cent.
1·80	+ 11·11	4·50	+ 11·11	·96	+ 0·81	·42	− 7·75
·81	+ 10·50	·51	+ 10·86	·97	+ 0·60	·43	− 7·92
·82	+ 9·89	·52	+ 10·62	·98	+ 0·40	·44	− 8·09
·83	+ 9·29	·53	+ 10·38	·99	+ 0·20	·45	− 8·26
·84	+ 8·70	·54	+ 10·13	5·00	Nil.	·46	− 8·42
·85	+ 8·11	·55	+ 9·89	·01	− 0·20	·47	− 8·59
·86	+ 7·53	·56	+ 9·65	·02	− 0·40	·48	− 8·76
·87	+ 6·95	·57	+ 9·41	·03	− 0·60	·49	− 8·93
·88	+ 6·38	·58	+ 9·17	·04	− 0·79	5·50	− 9·09
·89	+ 5·82	·59	+ 8·93	·05	− 0·99	·51	− 9·26
1·90	+ 5·26	4·60	+ 8·70	·06	− 1·19	·52	− 9·42
·91	+ 4·71	·61	+ 8·46	·07	− 1·38	·53	− 9·59
·92	+ 4·17	·62	+ 8·23	·08	− 1·57	·54	− 9·75
·93	+ 3·63	·63	+ 7·99	·09	− 1·77	·55	− 9·91
·94	+ 3·09	·64	+ 7·76	5·10	− 1·96	·56	− 10·07
·95	+ 2·56	·65	+ 7·53	·11	− 2·15	·57	− 10·23
·96	+ 2·04	·66	+ 7·30	·12	− 2·34	·58	− 10·39
·97	+ 1·52	·67	+ 7·07	·13	− 2·53	·59	− 10·55
·98	+ 1·01	·68	+ 6·84	·14	− 2·72	5·60	− 10·71
·99	+ 0·50	·69	+ 6·61	·15	− 2·91	·61	− 10·87
2·00	Nil.	4·70	+ 6·38	·16	− 3·10	·62	− 11·03
·01	− 0·50	·71	+ 6·16	·17	− 3·29	·63	− 11·19
·02	− 0·99	·72	+ 5·93	·18	− 3·47		
·03	− 1·48	·73	+ 5·71	·19	− 3·66		
·04	− 1·96	·74	+ 5·49	5·20	− 3·85		
·05	− 2·44	·75	+ 5·26	·21	− 4·03		
·06	− 2·91	·76	+ 5·04	·22	− 4·21		
·07	− 3·38	·77	+ 4·82	·23	− 4·40		
·08	− 3·85	·78	+ 4·60	·24	− 4·58		
·09	− 4·31	·79	+ 4·38	·25	− 4·76		
2·10	− 4·76	4·80	+ 4·17	·26	− 4·94		
·11	− 5·21	·81	+ 3·95	·27	− 5·12		
·12	− 5·66	·82	+ 3·73	·28	− 5·30		
·13	− 6·10	·83	+ 3·52	·29	− 5·48		
·14	− 6·54	·84	+ 3·31	5·30	− 5·66		
·15	− 6·98	·85	+ 3·09	·31	− 5·84		
·16	− 7·41	·86	+ 2·88	·32	− 6·02		
·17	− 7·83	·87	+ 2·67	·33	− 6·19		
·18	− 8·26	·88	+ 2·46	·34	− 6·37		
·19	− 8·68	·89	+ 2·25	·35	− 6·54		
2·20	− 9·09	4·90	+ 2·04	·36	− 6·72		
·21	− 9·50	·91	+ 1·83	·37	− 6·89		
·22	− 9·91	·92	+ 1·63	·38	− 7·06		
·23	*− 10·31*	·93	+ 1·42	·39	− 7·24		
·24	*− 10·71*	·94	+ 1·21	5·40	− 7·41		
	− 11·11	·95	+ 1·01	·41	− 7·58		

Meter Registering 10 feet.		Meter Registering 10 feet.		Meter Registering 10 feet.		Meter Registering 10 feet.	
Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.
Feet.	Per Cent.	Feet.	Per Cent.	Feet.	Per Cent.	Feet.	Per Cent.
9·00	+ 11·11	·46	+ 5·71	·92	+ 0·81	·38	— 3·66
·01	+ 10·99	·47	+ 5·60	·93	+ 0·70	·39	— 3·75
·02	+ 10·86	·48	+ 5·49	·94	+ 0·60	10·40	— 3·85
·03	+ 10·74	·49	+ 5.37	·95	+ 0·50	·41	— 3·94
·04	+ 10·62	9·50	+ 5·26	·96	+ 0·40	·42	— 4·03
·05	+ 10·50	·51	+ 5·15	·97	+ 0·30	·43	— 4·12
·06	+ 10·38	·52	+ 5·04	·98	+ 0·20	·44	— 4·21
·07	+ 10·25	·53	+ 4·93	·99	+ 0·10	·45	— 4·31
·08	+ 10·13	·54	+ 4·82	10.00	Nil.	·46	— 4·40
·09	+ 10·01	·55	+ 4·71	·01	— 0·10	·47	— 4·49
9·10	+ 9·89	·56	+ 4·60	·02	— 0·20	·48	— 4·58
·11	+ 9·77	·57	+ 4·49	·03	— 0·30	·49	— 4·67
12	+ 9·65	·58	+ 4·38	·04	— 0·40	10·50	— 4·76
·13	+ 9·53	·59	+ 4·28	·05	— 0·50	·51	- 4·85
·14	+ 9·41	9·60	+ 4·17	·06	— 0·60	·52	— 4·94
·15	+ 9·29	·61	+ 4·06	·07	— 0·70	·53	— 5·03
·16	+ 9·17	·62	+ 3·95	·08	— 0·79	·54	— 5·12
·17	+ 9·05	·63	+ 3·84	·09	— 0·89	·55	— 5·21
·18	+ 8·93	·64	+ 3·73	10·10	— 0·99	·56	— 5·30
·19	+ 8·81	·65	+ 3·63	·11	— 1·09	·57	— 5·39
9·20	+ 8·70	·66	+ 3·52	·12	— 1·19	·58	— 5·48
·21	+ 8·58	·67	+ 3·41	·13	— 1·28	·59	— 5·57
·22	+ 8·46	·68	+ 3·31	·14	— 1·38	10.60	— 5·66
·23	+ 8·34	·69	+ 3·20	·15	— 1·48	·61	— 5·75
·24	+ 8·23	9·70	+ 3·09	·16	— 1·57	·62	— 5·84
·25	+ 8·11	·71	+ 2·99	·17	— 1·67	·63	— 5·93
·26	+ 7·99	·72	+ 2·88	·18	— 1·77	·64	— 6·02
·27	+ 7 87	·73	+ 2·77	·19	— 1·86	·65	— 6·10
·28	+ 7·76	·74	+ 2·67	10·20	— 1·96	·66	— 6·19
·29	+ 7·64	·75	+ 2·56	·21	— 2·06	·67	— 6·28
9·30	+ 7·53	·76	+ 2·46	·22	— 2·15	·68	— 6·37
·31	+ 7·41	·77	+ 2·35	·23	— 2·25	·69	— 6·45
·32	+ 7·30	·78	+ 2·25	·24	— 2·34	10·70	— 6·54
·33	+ 7·18	·79	+ 2·15	·25	— 2·44	·71	— 6·63
·34	+ 7·07	9·80	+ 2·04	·26	— 2·53	·72	— 6·72
·35	+ 6·95	·81	+ 1·94	·27	— 2·63	·73	— 6·80
·36	+ 6·84	·82	+ 1·83	·28	— 2·72	·74	— 6·89
·37	+ 6·72	·83	+ 1·73	·29	— 2·82	·75	— 6·98
·38	+ 6·61	·84	+ 1·63	10.30	— 2·91	·76	— 7·06
·39	+ 6·50	·85	+ 1·52	·31	— 3·01	·77	— 7·15
9·40	+ 6·38	·86	+ 1·42	·32	— 3·10	·78	— 7·24
·41	+ 6·27	·87	+ 1·32	·33	— 3·19	·79	— 7·32
·42	+ 6·16	·88	+ 1·21	·34	— 3·29	10·80	— 7·41
·43	+ 6·04	·89	+ 1·11	·35	— 3·38	·81	— 7·49
·44	+ 5·93	9·90	+ 1·01	·36	— 3·47	·82	— 7·58
·45	+ 5·82	·91	+ 0·91	·37	— 3·57	·83	— 7·66

Meter Registering 10 feet.		Meter Registering' 20 feet.		Meter Registering 20 feet.		Meter Registering 20 feet.	
Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.
Feet.	Per Cent.	Feet.	Per Cent.	Feet.	Per Cent.	Feet.	Per Cent.
·84	— 7·75	18·00	+ 11·11	·46	+ 8·34	·92	+ 5·71
·85	— 7·83	·01	+ 11·05	·47	+ 8·29	·93	+ 5·65
·86	— 7·92	·02	+ 10·99	·48	+ 8·23	·94	+ 5·60
·87	— 8·00	·03	+ 10·92	·49	+ 8·17	·95	+ 5·54
·88	— 8·09	·04	+ 10·86	18·50	+ 8·11	·96	+ 5·49
·89	— 8·17	·05	+ 10·80	·51	+ 8·05	·97	+ 5·43
10·90	— 8·26	·06	+ 10·74	·52	+ 7·99	·98	+ 5·37
·91	— 8·34	·07	+ 10·68	·53	+ 7·93	·99	+ 5·31
·92	— 8·42	·08	+ 10·62	·54	+ 7·87	19·00	+ 5·26
·93	— 8·51	·09	+ 10·56	·55	+ 7·82	·01	+ 5·20
·94	— 8·59	18·10	+ 10·50	·56	+ 7·76	·02	+ 5·15
·95	— 8·68	·11	+ 10·44	·57	+ 7·70	·03	+ 5·09
·96	— 8·76	·12	+ 10·38	·58	+ 7·64	·04	+ 5·04
·97	— 8·84	·13	+ 10·31	·59	+ 7·59	·05	+ 4·98
·98	— 8·93	·14	+ 10·25	18·60	+ 7·53	·06	+ 4·93
·99	— 9·01	·15	+ 10·19	·61	+ 7·47	·07	+ 4·87
11·00	— 9·09	·16	+ 10·13	·62	+ 7·41	·08	+ 4·82
·01	— 9·18	·17	+ 10·07	·63	+ 7·36	·09	+ 4·76
·02	— 9·26	·18	+ 10·01	·64	+ 7·30	19·10	+ 4·71
·03	— 9·34	·19	+ 9·95	·65	+ 7·24	·11	+ 4·65
·04	— 9·42	18·20	+ 9·89	·66	+ 7·18	·12	+ 4·60
·05	— 9·51	·21	+ 9·83	·67	+ 7·13	.13	+ 4·54
·06	— 9·59	·22	+ 9·77	·68	+ 7·07	.14	+ 4·49
·07	— 9·67	·23	+ 9·71	·69	+ 7·01	.15	+ 4·43
·08	— 9·75	·24	+ 9·65	18·70	+ 6·95	.16	+ 4·38
·09	— 9·83	·25	+ 9·59	·71	+ 6·90	·17	+ 4·33
11·10	— 9·91	·26	+ 9·53	·72	+ 6·84	·18	+ 4·28
·11	— 9·99	·27	+ 9·47	·73	+ 6·78	·19	+ 4·22
·12	— 10·07	·28	+ 9·41	·74	+ 6·72	19·20	+ 4·17
·13	— 10·15	·29	+ 9·35	·75	+ 6·66	·21	+ 4·11
·14	— 10·23	18·30	+ 9·29	·76	+ 6·61	·22	+ 4·06
·15	— 10·31	·31	+ 9·23	·77	+ 6·55	·23	+ 4·00
·16	— 10·39	·32	+ 9·17	·78	+ 6·50	·24	+ 3·95
·17	— 10·47	·33	+ 9·11	·79	+ 6·44	·25	+ 3·89
·18	— 10·55	·34	+ 9·05	18·80	+ 6·38	·26	+ 3·84
·19	— 10·63	·35	+ 8·99	·81	+ 6·32	·27	+ 3·78
11·20	— 10·71	·36	+ 8·93	·82	+ 6·27	·28	+ 3·73
·21	— 10·79	·37	+ 8·87	·83	+ 6·21	·29	+ 3·68
·22	— 10·87	·38	+ 8·81	·84	+ 6·16	19·30	+ 3·63
·23	— 10·95	·39	+ 8·76	·85	+ 6·10	·31	+ 3·57
·24	— 11·03	18·40	+ 8·70	·86	+ 6·04	·32	+ 3·52
·25	— 11·11	·41	+ 8·64	·87	+ 5·98	·33	+ 3·46
		·42	+ 8·58	·88	+ 5·93	·34	+ 3·41
		·43	+ 8·52	·89	+ 5·87	·35	+ 3·36
		·44	+ 8·46	18·90	+ 5·82	·36	+ 3·31
		·45	+ 8·40	·91	+ 5·76	·37	+ 3·25

Meter Registering 20 feet.		Meter Registering 20 feet.		Meter Registering 20 feet.		Meter Registering 20 feet.	
Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.
Feet.	Per Cent.	Feet.	Per Cent.	Feet.	Per Cent.	Feet.	Per Cent.
·38	+ 3·20	·84	+ 0·81	20·60	— 2·91	·52	— 7·06
·39	+ 3·14	·85	+ 0·75	·62	— 3·01	·54	— 7·15
19·40	+ 3·09	·86	+ 0·70	·64	— 3·10	·56	— 7·24
·41	+ 3·04	·87	+ 0·65	·66	— 3·19	·58	— 7·32
·42	+ 2·99	·88	+ 0·60	·68	— 3·29	21·60	— 7·41
·43	+ 2·93	·89	+ 0·55	20·70	— 3·38	·62	— 7·49
·44	+ 2·88	19·90	+ 0·50	·72	— 3·47	·64	— 7·58
·45	+ 2·82	·91	+ 0·45	·74	— 3·57	·66	— 7·66
·46	+ 2·77	·92	+ 0·40	·76	— 3·66	·68	— 7·75
·47	+ 2·72	·93	+ 0·35	·78	— 3·75	21·70	— 7·83
·18	+ 2·67	·94	+ 0·30	20·80	— 3·85	·72	— 7·92
·49	+ 2·61	·95	+ 0·25	·82	— 3·94	·74	— 8·00
19·50	+ 2·56	·96	+ 0·20	·84	— 4·03	·76	— 8·09
·51	+ 2·51	·97	+ 0·15	·86	— 4·12	·78	— 8·17
·52	+ 2·46	·98	+ 0·10	·88	— 4·21	21·80	— 8·26
·53	+ 2·40	·99	+ 0·05	20·90	— 4·31	·82	— 8·34
·54	+ 2·35	20·00	Nil.	·92	— 4·40	·84	— 8·42
·55	+ 2·30	·02	— 0·10	·94	— 4·49	·86	— 8·51
·56	+ 2·25	·04	— 0·20	·96	— 4·58	·88	— 8·59
·57	+ 2·20	·06	— 0·30	·98	— 4·67	21·90	— 8·68
·58	+ 2·15	·08	— 0·40	21·00	— 4·76	·92	— 8·76
·59	+ 2·09	20·10	— 0·50	·02	— 4·85	·94	— 8·84
19·60	+ 2·04	·12	— 0·60	·04	— 4·94	·96	— 8·93
·61	+ 1·99	·14	— 0·70	·06	— 5·03	·98	— 9·01
·62	+ 1·94	·16	— 0·79	·08	— 5·12	22·00	— 9·09
·63	+ 1·88	·18	— 0·89	21·10	— 5·21	·02	— 9·18
·64	+ 1·83	20·20	— 0·99	·12	— 5·30	·04	— 9·26
·65	+ 1·78	·22	— 1·09	·14	— 5·39	·06	— 9·34
·66	+ 1·73	·24	— 1·19	·16	— 5·48	·08	— 9·42
·67	+ 1·68	·26	— 1·28	·18	— 5·57	22·10	— 9·51
·68	+ 1·63	·28	— 1·38	21·20	— 5·66	·12	— 9·59
·69	+ 1·57	20·30	— 1·48	·22	— 5·75	·14	— 9·67
19·70	+ 1·52	·32	— 1·57	·24	— 5·84	·16	— 9·75
·71	+ 1·47	·34	— 1·67	·26	— 5·93	·18	— 9·83
·72	+ 1·42	·36	— 1·77	·28	— 6·02	22·20	— 9·91
·73	+ 1·37	·38	— 1·86	21·30	— 6·10	·22	— 9·99
·74	+ 1·32	20·40	— 1·96	·32	— 6·19	·24	— 10·07
·75	+ 1·26	·42	— 2·06	·34	— 6·28	·26	— 10·15
·76	+ 1·21	·44	— 2·15	·36	— 6·37	·28	— 10·23
·77	+ 1·16	·46	— 2·25	·38	— 6·46	22·30	— 10·31
·78	+ 1·11	·48	— 2·34	21·40	— 6·54	·32	— 10·39
·79	+ 1·06	20·50	— 2·44	·42	— 6·63	·34	— 10·47
10·80	+ 1·01	·52	— 2·53	·44	— 6·72	·36	— 10·55
·81	+ 0·96	·54	— 2·63	·46	— 6·80	·38	— 10·63
·82	+ 0·91	·56	— 2·73	·48	— 6·80	22·40	— 10·71
·83	+ 0·86	·58	— 2·82	21·50	— 6·98	·42	— 10·79

Meter Registering 20 feet.		Meter Registering 30 feet.		Meter Registering 30 feet.		Meter Registeri 30 feet	
Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	A
Feet.	Per Cent.	Feet.	Per Cent.	Feet.	Per Cent.	Feet.	P
·44	− 10·87	27·00	+ 11·11	·92	+ 7·45	·84	+
·46	− 10·95	·02	+ 11·03	·94	+ 7·38	·86	+
·48	− 11·03	·04	+ 10·95	·96	+ 7·30	·88	+
22·50	− 11·11	·06	+ 10·86	·98	+ 7·22	28·90	+
		·08	+ 10·78	28·00	+ 7·14	·92	+
		27·10	+ 10·70	·02	+ 7·07	·94	+
		·12	+ 10·62	·04	+ 6·99	·96	+
		·14	+ 10·54	·06	+ 6·92	·98	+
		·16	+ 10·46	·08	+ 6·84	29·00	+
		·18	+ 10·38	28·10	+ 6·76	·02	+
		27·20	+ 10·30	·12	+ 6·69	·04	+
		·22	+ 10·21	·14	+ 6·61	·06	+
		·24	+ 10·13	·16	+ 6·53	·08	+
		·26	+ 10·05	·18	+ 6·46	29·10	+
		·28	+ 9·97	28·20	+ 6·38	·12	+
		27·30	+ 9·89	·22	+ 6·31	·14	+
		·32	+ 9·81	·24	+ 6·23	·16	+
		·34	+ 9·73	·26	+ 6·16	·18	+
		·36	+ 9·65	·28	+ 6·08	29·20	+
		·38	+ 9·57	28·30	+ 6·01	·22	+
		27·40	+ 9·49	·32	+ 5·93	·24	+
		·42	+ 9·41	·34	+ 5·86	·26	+
		·44	+ 9·33	·36	+ 5·78	·28	+
		·46	+ 9·25	·38	+ 5·71	29·30	+
		·48	+ 9·17	28·40	+ 5·63	·32	+
		27·50	+ 9·09	·42	+ 5·56	·34	+
		·52	+ 9·01	·44	+ 5·49	·36	+
		·54	+ 8·93	·46	+ 5·41	·38	+
		·56	+ 8·85	·48	+ 5·34	29·40	+
		·58	+ 8·78	28·50	+ 5·26	·42	+
		27·60	+ 8·70	·52	+ 5·19	·44	+
		·62	+ 8·62	·54	+ 5·11	·46	+
		·64	+ 8·54	·56	+ 5·04	·48	+
		·66	+ 8·46	·58	+ 4·96	29·50	+
		·68	+ 8·38	28·60	+ 4·89	·52	+
		27·70	+ 8·31	·62	+ 4·82	·54	+
		·72	+ 8·23	·64	+ 4·75	·56	+
		·74	+ 8·15	·66	+ 4·67	·58	+
		·76	+ 8·07	·68	+ 4·60	29·60	+
		·78	+ 7·99	28·70	+ 4·53	·62	+
		27·80	+ 7·92	·72	+ 4·45	·64	+
		·82	+ 7·84	·74	+ 4·38	·66	+
		·84	+ 7·76	·76	+ 4·31	·68	+
		·86	+ 7·68	·78	+ 4·24	29·70	+
		·88	+ 7·61	28·80	+ 4·17	·72	+
		27·90	+ 7·53	·82	+ 4·10	·74	+

Meter Registering 30 feet.		Meter Registering 30 feet.		Meter Registering 30 feet.		Meter Registering 30 feet.	
Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.
Feet.	Per Cent.	Feet.	Per Cent.	Feet.	Per Cent.	Feet.	Per Cent.
·76	+ 0·81	·68	— 2·22	31·60	— 5·06	·52	— 7·76
·78	+ 0·74	30·70	— 2·28	·62	— 5·12	·54	— 7·82
29·80	+ 0·67	·72	— 2·34	·64	— 5·18	·56	— 7·87
·82	+ 0·60	·74	— 2·40	·66	— 5·24	·58	— 7·93
·84	+ 0·53	·76	— 2·47	·68	— 5·30	32·60	— 7·98
·86	+ 0·47	·78	— 2·53	31·70	— 5·36	·62	— 8·04
·88	+ 0·40	30·80	— 2·60	·72	— 5·42	·64	— 8·10
29·90	+ 0·33	·82	— 2·66	·74	— 5·48	·66	— 8·15
·92	+ 0·26	·84	— 2·72	·76	— 5·54	·68	— 8·21
·94	+ 0·20	·86	— 2·78	·78	— 5·60	32·70	— 8·26
·96	+ 0·13	·88	— 2·85	31·80	— 5·66	·72	— 8·32
·98	+ 0·07	30·90	— 2·91	·82	— 5·72	·74	— 8·37
30·00	Nil.	·92	— 2·97	·84	— 5·78	·76	— 8·43
·02	— 0·07	·94	— 3·04	·86	— 5·84	·78	— 8·49
·04	— 0·13	·96	— 3·10	·88	— 5·90	32·80	— 8·54
·06	— 0·20	·98	— 3·16	31·90	— 5·96	·82	— 8·60
·08	— 0·27	31·00	— 3·22	·92	— 6·02	·84	— 8·66
30·10	— 0·33	·02	— 3·29	·94	— 6·08	·86	— 8·71
·12	— 0·40	·04	— 3·35	·96	— 6·13	·88	— 8·77
·14	— 0·47	·06	— 3·42	·98	— 6·19	32·90	— 8·82
·16	— 0·53	·08	— 3·48	32·00	— 6·25	·92	— 8·87
·18	— 0·60	31·10	— 3·54	·02	— 6·31	·94	— 8·93
30·20	— 0·66	·12	— 3·60	·04	— 6·37	·96	— 8·99
·22	— 0·73	·14	— 3·66	·06	— 6·42	·98	— 9·04
·24	— 0·79	·16	— 3·72	·08	— 6·48	33·00	— 9·09
·26	— 0·86	·18	— 3·79	32·10	— 6·54	·02	— 9·15
·28	— 0·92	31·20	— 3·85	·12	— 6·60	·04	— 9·20
30·30	— 0·99	·22	— 3·91	·14	— 6·66	·06	— 9·26
·32	— 1·06	·24	— 3·97	·16	— 6·72	·08	— 9·31
·34	— 1·12	·26	— 4·03	·18	— 6·77	33·10	— 9·36
·36	— 1·19	·28	— 4·09	32·20	— 6·83	·12	— 9·42
·38	— 1·26	31·30	— 4·16	·22	— 6·89	·14	— 9·47
30·40	— 1·32	·32	— 4·22	·24	— 6·95	·16	— 9·53
·42	— 1·38	·34	— 4·28	·26	— 7·01	·18	— 9·59
·44	— 1·44	·36	— 4·34	·28	— 7·07	33·20	— 9·64
·46	— 1·51	·38	— 4·40	32·30	— 7·12	·22	— 9·70
·48	— 1·57	31·40	— 4·46	·32	— 7·18	·24	— 9·75
30·50	— 1·64	·42	— 4·52	·34	— 7·24	·26	— 9·81
·52	— 1·71	·44	— 4·58	·36	— 7·30	·28	— 9·86
·54	— 1·77	·46	— 4·64	·38	— 7·36	33·30	— 9·91
·56	— 1·83	·48	— 4·70	32·40	— 7·41	·32	— 9·96
·58	— 1·89	31·50	— 4·76	·42	— 7·47	·34	— 10·01
30·60	— 1·96	·52	— 4·82	·44	— 7·53	·36	— 10·07
·62	— 2·02	·54	— 4·88	·46	— 7·59	·38	— 10·12
·64	— 2·09	·56	— 4·94	·48	— 7·64	33·40	— 10·18
·66	— 2·15	·58	— 5·00	32·50	— 7·70	·42	— 10·23

Meter Registering 30 feet.		Meter Registering 40 feet.		Meter Registering 40 feet.		Meter Registering 40 feet.	
Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.
Feet.	Per Cent.	Feet.	Per Cent.	Feet.	Per Cent.	Feet.	Per Cent.
·44	− 10·28	36·00	+ 11·11	·92	+ 8·34	·84	+ 5·71
·46	− 10·34	·02	+ 11·05	·94	+ 8·29	·86	+ 5·65
·48	− 10·39	·04	+ 10·99	·96	+ 8·23	·88	+ 5·60
33·50	− 10·45	·06	+ 10·92	·98	+ 8·17	37·90	+ 5·54
·52	− 10·50	·08	+ 10·86	37·00	+ 8·11	·92	+ 5·49
·54	− 10·55	36·10	+ 10·80	·02	+ 8·05	·94	+ 5·43
·56	− 10·61	·12	+ 10·74	·04	+ 7·99	·96	+ 5·37
·58	− 10·66	·14	+ 10·68	·06	+ 7·93	·98	+ 5·31
33·60	− 10·71	·16	+ 10·62	·08	+ 7·87	38·00	+ 5·26
·62	− 10·76	·18	+ 10·56	37·10	+ 7·82	·02	+ 5·20
·64	− 10·82	36·20	+ 10·50	·12	+ 7·76	·04	+ 5·15
·66	− 10·87	·22	+ 10·44	·14	+ 7·70	·06	+ 5·09
·68	− 10·93	·24	+ 10·38	·16	+ 7·64	·08	+ 5·04
33·70	− 10·98	·26	+ 10·31	·18	+ 7·59	38·10	+ 4·98
·72	− 11·03	·28	+ 10·25	37·20	+ 7·53	·12	+ 4·93
·74	− 11·09	36·30	+ 10·19	·22	+ 7·47	·14	+ 4·87
·76	− 11·14	·32	+ 10·13	·24	+ 7·41	·16	+ 4·82
·78	− 11·19	·34	+ 10·07	·26	+ 7·36	·18	+ 4·76
		·36	+ 10·01	·28	+ 7·30	38·20	+ 4·71
		·38	+ 9·95	37·30	+ 7·24	·22	+ 4·65
		36·40	+ 9·89	·32	+ 7·18	·24	+ 4·60
		·42	+ 9·83	·34	+ 7·13	·26	+ 4·54
		·44	+ 9·77	·36	+ 7·07	·28	+ 4·49
		·46	+ 9·71	·38	+ 7·01	38·30	+ 4·44
		·48	+ 9·65	37·40	+ 6·95	·32	+ 4·38
		36·50	+ 9·59	·42	+ 6·90	·34	+ 4·33
		·52	+ 9·53	·44	+ 6·84	·36	+ 4·28
		·54	+ 9·47	·46	+ 6·78	·38	+ 4·22
		·56	+ 9·41	·48	+ 6·72	38·40	+ 4·17
		·58	+ 9·35	37·50	+ 6·66	·42	+ 4·11
		36·60	+ 9·29	·52	+ 6·61	·44	+ 4·06
		·62	+ 9·23	·54	+ 6·55	·46	+ 4·00
		·64	+ 9·17	·56	+ 6·50	·48	+ 3·95
		·63	+ 9·11	·58	+ 6·44	38·50	+ 3·90
		·68	+ 9·05	37·60	+ 6·38	·52	+ 3·84
		36·70	+ 8·99	·62	+ 6·32	·54	+ 3·78
		·72	+ 8·93	·64	+ 6·27	·56	+ 3·73
		·74	+ 8·87	·66	+ 6·21	·58	+ 3·68
		·76	+ 8·81	·68	+ 6·16	38·60	+ 3·63
		·78	+ 8·76	37·70	+ 6·10	·62	+ 3·57
		36·80	+ 8·70	·72	+ 6·04	·64	+ 3·52
		·82	+ 8·64	·74	+ 5·98	·66	+ 3·46
		·84	+ 8·58	·76	+ 5·93	·68	+ 3·41
		·86	+ 8·52	·78	+ 5·87	38·70	+ 3·36
		·88	+ 8·46	37·80	+ 5·82	·72	+ 3·31
		36·90	+ 8·40	·82	+ 5·76	·74	+ 3·25

Meter Registering 40 feet.		Meter Registering 40 feet.		Meter Registering 40 feet.		Meter Registering 40 feet.	
Reading of Scale of Gas Holder	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.
Feet.	Per Cent.	Feet.	Per Cent.	Feet.	Per Cent.	Feet.	Per Cent.
·76	+ 3·20	·68	+ 0·81	40·60	— 1·48	·52	— 3·66
·78	+ 3·14	39·70	+ 0·75	·62	— 1·53	·54	— 3·71
38·80	+ 3·09	·72	+ 0·70	·64	— 1·57	·56	— 3·75
·82	+ 3·04	·74	+ 0·65	·66	— 1·62	·58	— 3·80
·84	+ 2·99	·76	+ 0·60	·68	— 1·67	41·60	— 3·85
·86	+ 2·93	·78	+ 0·55	40·70	— 1·72	·62	— 3·90
·88	+ 2·88	39·80	+ 0·50	·72	— 1·77	·64	— 3·94
38·90	+ 2·82	·82	+ 0·45	·74	— 1·82	·66	— 3·99
·92	+ 2·77	·84	+ 0·40	·76	— 1·86	·68	— 4·03
·94	+ 2·72	·86	+ 0·35	·78	— 1·91	41·70	— 4·08
·96	+ 2·67	·88	+ 0·30	40·80	— 1·96	·72	— 4·12
·98	+ 2·61	39·90	+ 0·25	·82	— 2·01	·74	— 4·17
39·00	+ 2·56	·92	+ 0·20	·84	— 2·06	·76	— 4·21
·02	+ 2·51	·94	+ 0·15	·86	— 2·10	·78	— 4·26
·04	+ 2·46	·96	+ 0·10	·88	— 2·15	41·80	— 4·31
·06	+ 2·40	·98	+ 0·05	40·90	— 2·20	·82	— 4·36
·08	+ 2·35	40·00	Nil.	·92	— 2·25	·84	— 4·40
39·10	+ 2·30	·02	— 0·05	·94	— 2·30	·86	— 4·45
·12	+ 2·25	·04	— 0·10	·96	— 2·34	·88	— 4·49
·14	+ 2·20	·06	— 0·15	·98	— 2·39	41·90	— 4·54
·16	+ 2·15	·08	— 0·20	41·00	— 2·44	·92	— 4·58
·18	+ 2·09	40·10	— 0·25	·02	— 2·49	·94	— 4·63
39·20	+ 2·04	·12	— 0·30	·04	— 2·53	·96	— 4·67
·22	+ 1·99	·14	— 0·35	·06	— 2·58	·98	— 4·72
·24	+ 1·94	·16	— 0·40	·08	— 2·63	42·00	— 4·76
·26	+ 1·88	·18	— 0·45	41·10	— 2·68	·02	— 4·81
·28	+ 1·83	40·20	— 0·50	·12	— 2·72	·04	— 4·85
39·30	+ 1·78	·22	— 0·55	·14	— 2·78	·06	— 4·90
·32	+ 1·73	·24	— 0·60	·16	— 2·82	·08	— 4·94
·34	+ 1·68	·26	— 0·65	·18	— 2·87	42·10	— 4·99
·36	+ 1·63	·28	— 0·70	41·20	— 2·91	·12	— 5·03
·38	+ 1·57	40·30	— 0·75	·22	— 2·96	·14	— 5·08
39·40	+ 1·52	·32	— 0·79	·24	— 3·01	·16	— 5·12
·42	+ 1·47	·34	— 0·84	·26	— 3·06	·18	— 5·17
·44	+ 1·42	·36	— 0·89	·28	— 3·10	42·20	— 5·21
·46	+ 1·37	·38	— 0·94	41·30	— 3·15	·22	— 5·26
·48	+ 1·32	40·40	— 0·99	·32	— 3·19	·24	— 5·30
39·50	+ 1·26	·42	— 1·04	·34	— 3·24	·26	— 5·35
·52	+ 1·21	·44	— 1·09	·36	— 3·29	·28	— 5·39
·54	+ 1·16	·46	— 1·14	·38	— 3·34	42·30	— 5·44
·56	+ 1·11	·48	— 1·19	41·40	— 3·38	·32	— 5·48
·58	+ 1·06	40·50	— 1·24	·42	— 3·43	·34	— 5·53
39·60	+ 1·01	·52	— 1·28	·44	— 3·47	·36	— 5·57
·62	+ 0·96	·54	— 1·33	·46	— 3·52	·38	— 5·62
·64	+ 0·91	·56	— 1·38	·48	— 3·57	42·40	— 5·66
·66	+ 0·86	·58	— 1·43	41·50	— 3·61	·42	— 5·71

Meter Registering 40 feet.		Meter Registering 40 feet.		Meter Registering 40 feet.		Meter Registering 50 feet.	
Reading of Scale of Gas Holder	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.
Feet.	Per Cent.	Feet.	Per Cent.	Feet.	Per Cent.	Feet.	Per Cent.
·44	— 5·75	·36	— 7·75	·28	— 9·67	45·00	+ 11·11
·46	— 5·80	·38	— 7·79	44·30	— 9·71	·02	+ 11·06
·48	— 5·84	43·40	— 7·83	·32	— 9·75	·04	+ 11·01
42·50	— 5·88	·42	— 7·88	·34	— 9·79	·06	+ 10·96
·52	— 5·93	·44	— 7·92	·36	— 9·83	·08	+ 10·91
·54	— 5·98	·46	— 7·96	·38	— 9·87	45·10	+ 10·86
·56	— 6·02	·48	— 8·00	44·40	— 9·91	·12	+ 10·81
·58	— 6·06	43·50	— 8·05	·42	— 9·95	·14	+ 10·76
42·60	— 6·10	·52	— 8·09	·44	— 9·99	·16	+ 10·72
·62	— 6·15	·54	— 8·13	·46	— 10·03	·18	+ 10·67
·64	— 6·19	·56	— 8·17	·48	— 10·07	45·20	+ 10·62
·66	— 6·24	·58	— 8·22	44·50	— 10·11	·22	+ 10·57
·68	— 6·28	43·60	— 8·26	·52	— 10·15	·24	+ 10·52
42·70	— 6·33	·62	— 8·30	·54	— 10·19	·26	+ 10·48
·72	— 6·37	·64	— 8·34	·56	— 10·23	·28	+ 10·43
·74	— 6·41	·66	— 8·38	·58	— 10·27	45·30	+ 10·38
·76	— 6·45	·68	— 8·42	44·60	— 10·31	·32	+ 10·33
·78	— 6·50	43·70	— 8·47	·62	— 10·35	·34	+ 10·28
42·80	— 6·54	·72	— 8·51	·64	— 10·39	·36	+ 10·23
·82	— 6·59	·74	— 8·55	·66	— 10·43	·38	+ 10·18
·84	— 6·63	·76	— 8·59	·68	— 10·47	45·40	+ 10·13
·86	— 6·68	·78	— 8·64	44·70	— 10·51	·42	+ 10·08
·88	— 6·72	43·80	— 8·68	·72	— 10·55	·44	+ 10·03
42·90	— 6·76	·82	— 8·72	·74	— 10·59	·46	+ 9·99
·92	— 6·80	·84	— 8·76	·76	— 10·63	·48	+ 9·94
·94	— 6·85	·86	— 8·80	·78	— 10·67	45·50	+ 9·89
·96	— 6·89	·88	— 8·84	44·80	— 10·71	·52	+ 9·84
·98	— 6·94	43·90	— 8·89	·82	— 10·75	·54	+ 9·79
43·00	— 6·98	·92	— 8·93	·84	— 10·79	·56	+ 9·75
·02	— 7·02	·94	— 8·97	·86	— 10·84	·58	+ 9·70
·04	— 7·06	·96	— 9·01	·88	— 10·87	45·60	+ 9·65
·06	— 7·11	·98	— 9·05	44·90	— 10·91	·62	+ 9·60
·08	— 7·15	44·00	— 9·09	·92	— 10·95	·64	+ 9·55
43·10	— 7·20	·02	— 9·14	·94	— 10·99	·66	+ 9·51
·12	— 7·24	·04	— 9·18	.96	— 11·03	·68	+ 9·46
·14	— 7·28	·06	— 9·22	·98	— 11·07	45·70	+ 9·41
·16	— 7·32	·08	— 9·26	45·00	— 11·11	·72	+ 9·36
·18	— 7·37	44·10	— 9·30			·74	+ 9·31
43·20	— 7·41	·12	— 9·34			·76	+ 9·27
·22	— 7·45	·14	— 9·38			·78	+ 9·22
·24	— 7·49	·16	— 9·42			45·80	+ 9·17
·26	— 7·54	·18	— 9·47			·82	+ 9·12
·28	— 7·58	44·20	— 9·51			·84	+ 9·07
43·30	— 7·62	·22	— 9·55			·86	+ 9·03
·32	— 7·66	·24	— 9·59			·88	+ 8·98
·34	— 7·71	·26	— 9·63			45·90	+ 8·93

Meter Registering 50 feet.		Meter Registering 50 feet.		Meter Registering 50 feet.		Meter Registering 50 feet.	
Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.
Feet.	Per Cent.	Feet.	Per Cent.	Feet.	Per Cent.	Feet.	Per Cent.
·92	+ 8·88	·84	+ 6·75	·76	+ 4·69	·68	+ 2·71
·94	+ 8·84	·86	+ 6·70	·78	+ 4·64	48·70	+ 2·67
·96	+ 8·79	·88	+ 6·66	47·80	+ 4·60	·72	+ 2·63
·98	+ 8·75	46·90	+ 6·61	·82	+ 4·56	·74	+ 2·59
46·00	+ 8·70	·92	+ 6·56	·84	+ 4·51	·76	+ 2·54
·02	+ 8·65	·94	+ 6·52	·86	+ 4·47	·78	+ 2·50
·04	+ 8·60	·96	+ 6·47	·88	+ 4·42	48·80	+ 2·46
·06	+ 8·56	·98	+ 6·43	47·90	+ 4·38	·82	+ 2·42
·08	+ 8·51	47·00	+ 6·38	·92	+ 4·34	·84	+ 2·38
46·10	+ 8·46	·02	+ 6·34	·94	+ 4·30	·86	+ 2·33
·12	+ 8·41	·04	+ 6·29	·96	+ 4·25	·88	+ 2·29
·14	+ 8·37	·06	+ 6·25	·98	+ 4·21	48·90	+ 2·25
·16	+ 8·32	·08	+ 6·20	48·00	+ 4·17	·92	+ 2·21
·18	+ 8·28	47·10	+ 6·16	·02	+ 4·13	·94	+ 2·17
46·20	+ 8·23	·12	+ 6·11	·04	+ 4·08	·96	+ 2·12
·22	+ 8·18	·14	+ 6·07	·06	+ 4·04	·98	+ 2·08
·24	+ 8·13	·16	+ 6·02	·08	+ 3·99	49·00	+ 2·04
·26	+ 8·09	·18	+ 5·98	48·10	+ 3·95	·02	+ 2·00
·28	+ 8·04	47·20	+ 5·93	·12	+ 3·91	·04	+ 1·96
46·30	+ 7·99	·22	+ 5·89	·14	+ 3·86	·06	+ 1·91
·32	+ 7·94	·24	+ 5·84	·16	+ 3·82	·08	+ 1·87
·34	+ 7·90	·26	+ 5·80	·18	+ 3·77	49·10	+ 1·83
·36	+ 7·85	·28	+ 5·75	48·20	+ 3·73	·12	+ 1·79
·38	+ 7·81	47·30	+ 5·71	·22	+ 3·69	·14	+ 1·75
46·40	+ 7·76	·32	+ 5·67	·24	+ 3·65	·16	+ 1·71
·42	+ 7·71	·34	+ 5·62	·26	+ 3·60	·18	+ 1·67
·44	+ 7·67	·36	+ 5·58	·28	+ 3·56	49·20	+ 1·63
·46	+ 7·62	·38	+ 5·53	48·30	+ 3·52	·22	+ 1·59
·48	+ 7·58	47·40	+ 5·49	·32	+ 3·48	·24	+ 1·55
46·50	+ 7·53	·42	+ 5·44	·34	+ 3·44	·26	+ 1·50
·52	+ 7·48	·44	+ 5·40	·36	+ 3·39	·28	+ 1·46
·54	+ 7·44	·46	+ 5·35	·38	+ 3·35	49·30	+ 1·42
·56	+ 7·39	·48	+ 5·31	48·40	+ 3·31	·32	+ 1·38
·58	+ 7·35	47·50	+ 5·26	·42	+ 3·27	·34	+ 1·34
46·60	+ 7·30	·52	+ 5·22	·44	+ 3·22	·36	+ 1·29
·62	+ 7·25	·54	+ 5·17	·46	+ 3·18	·38	+ 1·25
·64	+ 7·21	·56	+ 5·13	·48	+ 3·13	49·40	+ 1·21
·66	+ 7·16	·58	+ 5·08	48·50	+ 3·09	·42	+ 1·17
·68	+ 7·12	47·60	+ 5·04	·52	+ 3·05	·44	+ 1·13
46·70	+ 7·07	·62	+ 5·00	·54	+ 3·01	·46	+ 1·09
·72	+ 7·02	·64	+ 4·95	·56	+ 2·96	·48	+ 1·05
·74	+ 6·98	·66	+ 4·91	·58	+ 2·92	49·50	+ 1·01
·76	+ 6·93	·68	+ 4·86	48·60	+ 2·88	·52	+ 0·97
·78	+ 6·89	47·70	+ 4·82	·62	+ 2·84	·54	+ 0·93
46·80	+ 6·84	·72	+ 4·78	·64	+ 2·80	·56	+ 0·89
·82	+ 6·79	·74	+ 4·73	·66	+ 2·75	·58	+ 0·85

Meter Registering 50 feet.		Meter Registering 50 feet.		Meter Registering 50 feet.		Meter Registering 50 feet.	
Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.
Feet.	Per Cent.	Feet.	Per Cent.	Feet.	Per Cent.	Feet.	Per Cent.
49·60	+ 0·81	·52	— 1·03	·44	— 2·80	·90	— 5·48
·62	+ 0·77	·54	— 1·07	·46	— 2·83	·95	— 5·57
·64	+ 0·73	·56	— 1·11	·48	— 2·87	53·00	— 5·66
·66	+ 0·68	·58	— 1·15	51·50	— 2·91	·05	— 5·75
·68	+ 0·64	50·60	— 1·19	·52	— 2·95	·10	— 5·84
49·70	+ 0·60	·62	— 1·23	·54	— 2·99	·15	— 5·93
·72	+ 0·56	·64	— 1·27	·56	— 3·02	·20	— 6·02
·74	+ 0·52	·66	— 1·30	·58	— 3·06	·25	— 6·10
·76	+ 0·48	·68	— 1·34	51·60	— 3·10	·30	— 6·19
·78	+ 0·44	50·70	— 1·38	·62	— 3·14	·35	— 6·28
49·80	+ 0·40	·72	— 1·42	·64	— 3·18	·40	— 6·37
·82	+ 0·36	·74	— 1·46	·66	— 3·21	·45	— 6·45
·84	+ 0·32	·76	— 1·49	·68	— 3·25	53·50	— 6·54
·86	+ 0·28	·78	— 1·53	51·70	— 3·29	·55	— 6·63
·88	+ 0·24	50·80	— 1·57	·72	— 3·33	·60	— 6·72
49·90	+ 0·20	·82	— 1·61	·74	— 3·36	·65	— 6·80
·92	+ 0·16	·84	— 1·65	·76	— 3·40	·70	— 6·89
·94	+ 0·12	·86	— 1·69	·78	— 3·43	·75	— 6·98
·96	+ 0·08	·88	— 1·73	51·80	— 3·47	·80	— 7·06
·98	+ 0·04	50·90	— 1·77	·82	— 3·51	·85	— 7·15
50·00	Nil.	·92	— 1·81	·84	— 3·55	·90	— 7·24
·02	— 0·04	·94	— 1·85	·86	— 3·58	·95	— 7·32
·04	— 0·08	·96	— 1·88	·88	— 3·62	54·00	— 7·41
·06	— 0·12	·98	— 1·92	51·90	— 3·66	·05	— 7·49
·08	— 0·16	51·00	— 1·96	·92	— 3·70	·10	— 7·58
50·10	— 0·20	·02	— 2·00	·94	— 3·74	·15	— 7·66
·12	— 0·24	·04	— 2·04	·96	— 3·77	·20	— 7·75
·14	— 0·28	·06	— 2·07	·98	— 3·81	·25	— 7·83
·16	— 0·32	·08	— 2·11	52·00	— 3·85	·30	— 7·92
·18	— 0·36	51·10	— 2·15	·05	— 3·94	·35	— 8·00
50·20	— 0·40	·12	— 2·19	·10	— 4·03	·40	— 8·09
·22	— 0·44	·14	— 2·23	·15	— 4·12	·45	— 8·17
·24	— 0·48	·16	— 2·26	·20	— 4·21	54·50	— 8·26
·26	— 0·52	·18	— 2·30	·25	— 4·31	·55	— 8·34
·28	— 0·56	51·20	— 2·34	·30	— 4·40	·60	— 8·42
50·30	— 0·60	·22	— 2·38	·35	— 4·49	·65	— 8·51
·32	— 0·64	·24	— 2·42	·40	— 4·58	·70	— 8·59
·34	— 0·68	·26	— 2·45	·45	— 4·67	·75	— 8·68
·36	— 0·71	·28	— 2·49	52·50	— 4·76	·80	— 8·76
·38	— 0·75	51·30	— 2·53	·55	— 4·85	·85	— 8·84
50·40	— 0·79	·32	— 2·57	·60	— 4·94	·90	— 8·93
·42	— 0·83	·34	— 2·61	·65	— 5·03	·95	— 9·01
·44	— 0·87	·36	— 2·65	·70	— 5·12	55·00	— 9·09
·46	— 0·91	·38	— 2·69	·75	— 5·21	·05	— 9·18
·48	— 0·95	51·40	— 2·72	·80	— 5·30	·10	— 9·26
50·50	— 0·99	·42	— 2·76	·85	— 5·39	·15	— 9·34

Meter Registering 50 feet.		Meter Registering 100 feet.		Meter Registering 100 feet.		Meter Registering 100 feet.	
Reading of Scale of Gas Holder	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.
Feet.	Per Cent.	Feet.	Per Cent.	Feet.	Per Cent.	Feet.	Per Cent.
·20	— 9·42	90·00	+ 11·11	·30	+ 8·34	·60	+ 5·71
·25	— 9·51	·05	+ 11·05	·35	+ 8·29	·65	+ 5·65
·30	— 9·59	·10	+ 10·99	·40	+ 8·23	·70	+ 5·60
·35	— 9·67	·15	+ 10·92	·45	+ 8·17	·75	+ 5·54
·40	— 9·75	·20	+ 10·86	92·50	+ 8·11	·80	+ 5·49
·45	— 9·83	·25	+ 10·80	·55	+ 8·05	·85	+ 5·43
55·50	— 9·91	·30	+ 10·74	·60	+ 7·99	·90	+ 5·37
·55	— 9·99	·35	+ 10·68	·65	+ 7·93	·95	+ 5·31
·60	— 10·07	·40	+ 10·62	·70	+ 7·87	95·00	+ 5·26
·65	— 10·15	·45	+ 10·56	·75	+ 7·82	·05	+ 5·20
·70	— 10·23	90·50	+ 10·50	·80	+ 7·76	·10	+ 5·15
·75	— 10·31	·55	+ 10·44	·85	+ 7·70	·15	+ 5·09
·80	— 10·39	·60	+ 10·38	·90	+ 7·64	·20	+ 5·04
·85	— 10·47	·65	+ 10·31	·95	+ 7·59	·25	+ 4·98
·90	— 10·55	·70	+ 10·25	93·00	+ 7·53	·30	+ 4·93
·95	— 10·63	·75	+ 10·19	·05	+ 7·47	·35	+ 4·87
56·00	— 10·71	·80	+ 10·13	·10	+ 7·41	·40	+ 4·82
·05	— 10·79	·85	+ 10·07	·15	+ 7·36	·45	+ 4·76
·10	— 10·87	·90	+ 10·01	·20	+ 7·30	95·50	+ 4·71
·15	— 10·95	·95	+ 9·95	·25	+ 7·24	·55	+ 4·65
·20	— 11·03	91·00	+ 9·89	·30	+ 7·18	·60	+ 4·60
·25	— 11·11	·05	+ 9·83	·35	+ 7·13	·65	+ 4·54
		·10	+ 9·77	·40	+ 7·07	·70	+ 4·49
		·15	+ 9·71	·45	+ 7·01	·75	+ 4·43
		·20	+ 9·65	93·50	+ 6·95	·80	+ 4·38
		·25	+ 9·59	·55	+ 6·90	·85	+ 4·33
		·30	+ 9·53	·60	+ 6·84	·90	+ 4·28
		·35	+ 9·47	·65	+ 6·78	·95	+ 4·22
		·40	+ 9·41	·70	+ 6·72	96·00	+ 4·17
		·45	+ 9·35	·75	+ 6·66	·05	+ 4·11
		91·50	+ 9·29	·80	+ 6·61	·10	+ 4·06
		·55	+ 9·23	·85	+ 6·55	·15	+ 4·00
		·60	+ 9·17	·90	+ 6·50	·20	+ 3·95
		·65	+ 9·11	·95	+ 6·44	·25	+ 3·89
		·70	+ 9·05	94·00	+ 6·38	·30	+ 3·84
		·75	+ 8·99	·05	+ 6·32	·35	+ 3·78
		·80	+ 8·93	·10	+ 6·27	·40	+ 3·73
		·85	+ 8·87	·15	+ 6·21	·45	+ 3·68
		·90	+ 8·81	·20	+ 6·16	96·50	+ 3·63
		·95	+ 8·76	·25	+ 6·10	·55	+ 3·57
		92·00	+ 8·70	·30	+ 6·04	·60	+ 3·52
		·05	+ 8·64	·35	+ 5·98	·65	+ 3·46
		·10	+ 8·58	·40	+ 5·93	·70	+ 3·41
		·15	+ 8·52	·45	+ 5·87	·75	+ 3·36
		·20	+ 8·46	94·50	+ 5·82	·80	+ 3·31
		·25	+ 8·40	·55	+ 5·76	·85	+ 3·25

Meter Registering 100 feet.		Meter Registering 100 feet.		Meter Registering 100 feet.		Meter Registering 100 feet.	
Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.
Feet.	Per Cent.	Feet.	Per Cent.	Feet.	Per Cent.	Feet.	Per Cent.
·90	+ 3·20	·20	+ 0·81	101·50	— 1·48	·80	— 3·66
·95	+ 3·14	·25	+ 0·75	·55	— 1·53	·85	— 3·71
97·00	+ 3·09	·30	+ 0·70	·60	— 1·57	·90	— 3·75
·05	+ 3·04	·35	+ 0·65	·65	— 1·62	·95	— 3·80
·10	+ 2·99	·40	+ 0·60	·70	— 1·67	104·00	— 3·85
·15	+ 2·93	·45	+ 0·55	·75	— 1·72	·05	— 3·90
·20	+ 2·88	99·50	+ 0·50	·80	— 1·77	·10	— 3·94
·25	+ 2·82	·55	+ 0·45	·85	— 1·82	·15	— 3·99
·30	+ 2·77	·60	+ 0·40	·90	— 1·87	·20	— 4·03
·35	+ 2·72	·65	+ 0·35	·95	— 1·91	·25	— 4·08
·40	+ 2·67	·70	+ 0·30	102·00	— 1·96	·30	— 4·12
·45	+ 2·61	·75	+ 0·25	·05	— 2·01	·35	— 4·17
97·50	+ 2·56	·80	+ 0·20	·10	— 2·06	·40	— 4·21
·55	+ 2·51	·85	+ 0·15	·15	— 2·10	·45	— 4·26
·60	+ 2·46	·90	+ 0·10	·20	— 2·15	104·50	— 4·31
·65	+ 2·40	·95	+ 0·05	·25	— 2·20	·55	— 4·36
·70	+ 2·35	100.00	Nil.	·30	— 2·25	·60	— 4·40
·75	+ 2·30	·05	— 0·05	·35	— 2·30	·65	— 4·45
·80	+ 2·25	·10	— 0·10	·40	— 2·34	·70	— 4·49
·85	+ 2·20	·15	— 0·15	·45	— 2·39	·75	— 4·54
·90	+ 2·15	·20	— 0·20	102·50	— 2·44	·80	— 4·58
·95	+ 2·09	·25	— 0·25	·55	— 2·49	·85	— 4·63
98·00	+ 2·04	·30	— 0·30	·60	— 2·53	·90	— 4·67
·05	+ 1·99	·35	— 0·35	·65	— 2·58	·95	— 4·72
·10	+ 1·94	·40	— 0·40	·70	— 2·63	105·00	— 4·76
·15	+ 1·88	·45	— 0·45	·75	— 2·68	·05	— 4·81
·20	+ 1·83	100·50	— 0·50	·80	— 2·72	·10	— 4·85
·25	+ 1·78	·55	— 0·55	·85	— 2·78	·15	— 4·90
·30	+ 1·73	·60	— 0·60	·90	— 2·82	·20	— 4·94
·35	+ 1·68	·65	— 0·65	·95	— 2·87	·25	— 4·99
·40	+ 1·63	·70	— 0·70	103·00	— 2·91	·30	— 5·03
·45	+ 1·57	·75	— 0·75	·05	— 2·96	·35	— 5·08
98·50	+ 1·52	·80	— 0·79	·10	— 3·01	·40	— 5·12
·55	+ 1·47	·85	— 0·84	·15	— 3·06	·45	— 5·17
·60	+ 1·42	·90	— 0·89	·20	— 3·10	105·50	— 5·21
·65	+ 1·37	·95	— 0·94	·25	— 3·15	·55	— 5·26
·70	+ 1·32	101·00	— 0·99	·30	— 3·19	·60	— 5·30
·75	+ 1·26	·05	— 1·04	·35	— 3·24	·65	— 5·35
·80	+ 1·21	·10	— 1·09	·40	— 3·29	·70	— 5·39
·85	+ 1·16	·15	— 1·14	·45	— 3·34	·75	— 5·44
·90	+ 1·11	·20	— 1·19	103·50	— 3·38	·80	— 5·48
·95	+ 1·06	·25	— 1·24	·55	— 3·43	·85	— 5·53
99·00	+ 1·01	·30	— 1·28	·60	— 3·47	·90	— 5·57
·05	+ 0·96	·35	— 1·33	·65	— 3·52	·95	— 5·62
·10	+ 0·91	·40	— 1·38	·70	— 3·57	106·00	— 5·66
·15	+ 0·86	·45	— 1·43	·75	— 3·61	·05	— 5·71

Meter Registering 100 feet.		Meter Registering 100 feet.		Meter Registering 100 feet.		Meter Registering 100 feet.	
Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.	Reading of Scale of Gas Holder.	Amount of Error.
Feet.	Per Cent.	Feet.	Per Cent.	Feet.	Per Cent.	Feet.	Per Cent.
·10	— 5·75	·40	— 6·89	·70	— 8·00	110·00	— 9·00
·15	— 5·80	·45	— 6·94	·75	— 8·05	·10	— 9·18
·20	— 5·84	107·50	— 6·98	·80	— 8·09	·20	— 9·26
·25	— 5·88	·55	— 7·02	·85	— 8·13	·30	— 9·34
·30	— 5·93	·60	— 7·06	·90	— 8·17	·40	— 9·42
·35	— 5·98	·65	— 7·11	·95	— 8·22	·50	— 9·51
·40	— 6·02	·70	— 7·15	109·00	— 8·26	·60	— 9·59
·45	— 6·06	·75	— 7·20	·05	— 8·30	·70	— 9·67
106·50	— 6·10	·80	— 7·24	·10	— 8·34	·80	— 9·75
·55	— 6·15	·85	— 7·28	·15	— 8·38	·90	— 9·83
·60	— 6·19	·90	— 7·32	·20	— 8·42	111·00	— 9·91
·65	— 6·24	·95	— 7·37	·25	— 8·47	·10	— 9·99
·70	— 6·28	108·00	— 7·41	·30	— 8·51	·20	— 10·07
·75	— 6·33	·05	— 7·45	·35	— 8·55	·30	— 10·15
·80	— 6·37	·10	— 7·49	·40	— 8·59	·40	— 10·23
·85	— 6·41	·15	— 7·54	·45	— 8·64	·50	— 10·31
·90	— 6·45	·20	— 7·58	109·50	— 8·68	·60	— 10·39
·95	— 6·50	·25	— 7·62	·55	— 8·72	·70	— 10·47
107·00	— 6·54	·30	— 7·66	·60	— 8·76	·80	— 10·55
·05	— 6·59	·35	— 7·71	·65	— 8·80	·90	— 10·63
·10	— 6·63	·40	— 7·75	·70	— 8·84	112·00	— 10·71
·15	— 6·68	·45	— 7·79	·75	— 8·89	·10	— 10·79
·20	— 6·72	108·50	— 7·83	·80	— 8·93	·20	— 10·87
·25	— 6·76	·55	— 7·88	·85	— 8·97	·30	— 10·95
·30	— 6·80	·60	— 7·92	·90	— 9·01	·40	— 11·03
·35	— 6·85	·65	— 7·96	·95	— 9·05	·50	— 11·11

TESTING ROOM BOOK.

BOROUGH OF

Date when Tested.	Number of Lights.	Maker's Name.	Maker's Number.	Capacity.		Kind of Meter.	Leakage Pressure, 3 inches.	Test for Per Centage of Error, 5-10ths inch Pressure.												Remarks.
								Fast.						Slow.						
				Per Revolution. Cub. ft.	Per Hour. Cub. ft.			Passed from Holder.	Registered by Meter.	Temperature.		Correction for Temp. per Cent.	Per Cent. Error.	Passed from Holder.	Registered by Meter.	Temperature.		Correction for Temp. per Cent.	Per Cent. Error.	
										Outlet Holder.	Outlet Meter.					Outlet Holder.	Outlet Meter.			
1869.																				
Jan. 14	3	James Jobson	19,785	·125	18	Wet	0	4·97	5·0	67°	65°	·5	1·11	5·15	5·0	67°	65°	·5	2·43	
,,	5	Ditto	18,546	·166	30	Dry	0	9·8	10·0	65°	67°	·5	1·52	..	..	..	..	..	..	
,,	10	Hall & Co. ..	7,438	·5	60	Wet	Unsound	..	..	..	..	..	..	..	..	...	..	..	..	Rejected.
,,	20	Ditto	7,439	1·0	120	Ditto	0	39·0	40·	52°	56°	1·0	1·54	40·6	40·	52°	56°	1·0	2·44	

RECEIPT AND DELIVERY BOOK.

BOROUGH OF

Date when Received.	From whom Received.	Maker's Name.	Maker's Number.	Kind of Meter.	Capacity per Revolution. Cub. ft.	Fees.	Date when Tested.	Date when delivered.	To whom delivered.	Signature.
1869.						s. d.	1869.	1869.		
Jan. 13.	James Jobson	John Hills ..	19,785	Wet	·125	0 6	Jan. 14.	Jan. 14.	Jobson, per lad..	W. Brown.
„	John Hills ..	Ditto	18,546	Dry	·166	0 6	„	„ 15.	Hills, per Carman	A. Jones.
„	Hall & Co. ..	Hall & Co. ..	7,438	Wet	·5	1 0	„	„ 17.	Hall, per man ..	J. Edwards.
„	Ditto	Ditto	7,439	Ditto	1·0	1 0	„	„	Ditto	

GAS METER INSPECTOR'S OFFICE,
(*Name of Borough*)
....18..........

Received of..

the Meters herein described, and the several fees payable for Examining and Testing them, under Sec. 19 of the Sales of Gas Act.

Maker's Name.	Maker's Number.	Wet or Dry.	Capacity per Revolution. Cubic Feet.	Fees. £	s.	d.
Wright & Co.	47,300	Wet	·125	0	0	6
Ditto........	54,000	Dry	3·0	0	3	0
Ditto........	54,001	Dry	6·0	0	6	0
Ditto........	12 Meters No. 65,000 to 65,011	Wet	·5	0	12	0
				£1	1	6

....

Inspector.

GAS METER INSPECTOR'S OFFICE, (*Name of Borough*).

.... 18 ....

I HEREBY certify that the undermentioned Meters were examined and tested by me, in accordance with the 12th and 13th Clauses of the Sales of Gas Act, and* .... fulfilling the requirements of the said Act, were† .... by me.

.... *Inspector.*

Date when Tested.	Maker's Name.	Maker's Number.	No. of Lights.	Reading of Index in Cubic Feet.	Result of Test.
1869. January 14	John Hills ..	19,785	3	Zero	Correct
” ”	” ” ...	18,546	5	1,500	”

---

* Insert a dash if the meter be correct, and the word "Not" if incorrect.

† Insert "Stamped" if correct, and "Rejected" if incorrect.

ALEXANDER WRIGHT & Co., Engineers,

CONSUMERS' GAS METERS,

Wet and Dry,

(See Figs. 5 and 6, "Gas Measurement, &c.")

GAS GOVERNORS

(Wet and Dry),

For regulating the pressure of gas in public and private buildings.

STATION METERS,

In cylindrical and rectangular cases (see Figs. 8, 9 and 10, "Gas Measurement, &c.")

STATION GOVERNORS FOR GAS WORKS,

For large or small mains, with floated gas-holders, or with lever or pulley compensation weights.

EXHAUST GOVERNORS AND THROTTLE VALVES.

BYE PASSES FOR STATION METERS AND GOVERNORS, &c., of every Construction.

---

55 and 55a, Millbank Street, Westminster, S.W.

ALEXANDER WRIGHT & Co., Engineers,

PRESSURE REGISTERS.

EXHAUST REGISTERS.

WRIGHT'S REGISTERING AND EXHAUST GAUGES.

KING'S GAUGES,

For any pressure or exhaust.

PRESSURE GAUGES

Of every form and size.

POCKET PRESSURE GAUGES,

In leather cases, with plyers, burner brooches, &c.

WATER LEVEL GAUGES.

BOURDON'S and other STEAM GAUGES.

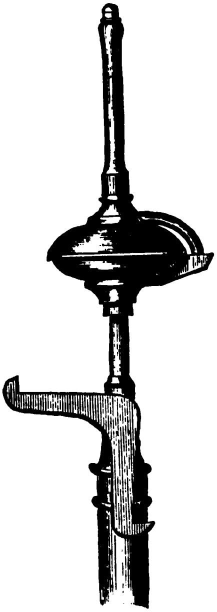
55 and 55a, Millbank Street, Westminster, S.W.

ALEXANDER WRIGHT & Co.. Engineers,

STREET LAMP REGULATORS,

With lava or other burners adjusted to any rate of consumption,

£14 per 100.



LANTERN COCKS.

Lever and ordinary.

LIGHTING POLES AND LAMPS.

METERS AND METER BOXES AND LAMP COLUMNS,

For Public Lights.

LANTERNS, LANTERN FRAMES,

And every requisite for Public Lighting.

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PHOTOMETRIC APPARATUS.

IMPROVED BUNSEN-LETHEBY PHOTOMETER,

With Hartley's Balance for weighing candles while burning and in position.

ORDINARY BUNSEN PHOTOMETERS.

EXPERIMENTAL METERS AND GOVERNORS.

MINUTE CLOCKS.

STANDARD BURNERS AND CANDLES.

INFERENTIAL OR JET PHOTOMETERS.

From the simplest kind to the most improved, in glazed case

55 and 55a, Millbank Street, Westminster, S.W.

ALEXANDER WRIGHT & Co., Engineers,

APPARATUS FOR THE ANALYSIS OF COAL AND COAL GAS.

THOMPSON'S APPARATUS FOR TESTING THE HEATING POWERS OF FUEL.

SPECIFIC GRAVITY APPARATUS.

THOMPSON'S COOPERS' TUBE APPARATUS.

WRIGHT'S, LETHEBY'S, THE GAS REFEREES', AND VALENTIN'S SULPHUR TESTS.

REFEREES' AMMONIA TEST.

EXPERIMENTAL METERS,
With Dry Governors for use with Ammonia and Sulphur Tests.

These meters stop the supply of gas when 10 cubic feet have passed.

CHEMICALS, GLASS, &c.

CHEMICAL BALANCES.

METEOROLOGICAL INSTRUMENTS.
BAROMETERS, THERMOMETERS, WIND GAUGES, &c.

---

55 and 55a, Millbank Street, Westminster, S.W.

GAS-METER TESTINC APPARATUS,

(AS DESCRIBED IN "GAS MEASUREMENT, &c.")

SEE FRONTISPIECE.

	£	s.	d.
GASHOLDER, 11 cubic feet measuring capacity, painted and varnished	44	0	0
GASHOLDER, 5½ cubic feet measuring capacity ...	33	0	0
GASHOLDER, $\frac{1}{10}$th cubic feet measuring capacity ...	20	0	0
The foregoing are the three sizes recognised by Government, and used by Inspectors under the "Sales of Gas Act," but any other size will be made to order, and in every case carefully graduated to agree with the Government standards of cubic capacity.			
BRASS CONES to fit the Unions of Meters, from 1 light up to 200 lights, with 10-ft. 2-in. flexible tube fitted with brass ends, for cones to screw into, per set for one gasholder	5	0	0
Proving Bench, **SLATE CISTERN**, with ball-cock and waste-pipe; or **strong-framed Table**, covered with lead, and fitted with waste-pipe	9	9	0
PUMP, to charge wet meters with water	4	0	0
FLOAT, 20 burners, on 2-in. tube, with blow-off cock at one end...	4	0	0
DOUBLE-BLAST BELLOWS, for filling holders with air	7	7	0
GAS TORCH, with 10 ft. of flexible tube. Per pair	1	1	0
THERMOMETERS, for water or air, from 5*s.* to ...	0	10	0

	£ s. d.
MINUTE CLOCK, best make, mahogany case with glass front, 39-in. pendulum, beating seconds and striking each minute ... ... 5 5 0 and	7 10 0
TABLES OF PER-CENTAGE OF ERROR, on sheet, 6*d*,; on board and varnished	0 5 0

TEST METERS.

5-Light	from 5 0 0	to	15 0 0
10 „	„ 10 0 0	„	20 0 0
20 „	„ 15 0 0	„	40 0 0
100 „	„ 30 0 0	„	90 0 0

The higher prices are for instruments similar to those made for the STANDARDS DEPARTMENT OF THE BOARD OF TRADE, by Alex. Wright and Co. (see Fig. 7, Gas Measurement).

GAS-METER TESTING APPARATUS have been supplied by A. WRIGHT & Co., for the purposes of the "Sales of Gas Act," to the Authorities of the following, as well as to other places :—

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BATH,
NEWPORT,
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BRIGHTON,
SCARBOROUGH,
WORCESTER,
NORTHAMPTON,
WIDNES,
THE METROPOLITAN BOARD OF WORKS,

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E. S. DUPLICATE

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